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DESCRIPTION OF CURRENT CONDITIONS
U.S. STEEL FAIRLESS WORKS

PREPARED FOR

U.S. STEEL

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BCM PROJECT NO. 00-5039-70

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1.0 EXECUTIVE SUMMARY

This report describes what is known about the current physical and environmental conditions at the U.S. Steel Fairless Works in Fairless Hills, Pennsylvania. Environmental work at the site is being performed under the Resource Conservation and Recovery Act (RCRA), EPA Docket Number RCRA-III-065-CA.

This current conditions report provides background information and, as such, becomes a basis for the RCRA Facility Investigation (RFI). Information presented herein includes background descriptions of the site, available information and data concerning wastes and contamination at the site, and measures which have been taken in the past to address releases. Section 4.0 of this report further provides an overview of potential releases and migration pathways and describes those elements of the site which, at this point in time, appear to warrant more attention in the RFI as well as those elements which do not now appear to be significant.

Section 2.0 provides an introduction to this report. Section 3.1 provides an excellent general description of the site with respect to its setting in the environment. Although much of this information is from literature sources, it has been confirmed by detailed investigation and experience on a nearby site (Rohm and Haas Facility in Bristol, Pennsylvania) and by the available data from this site.

Because the site was developed in relatively recent times, a significant history of the site uses is available. Section 3.2 includes a description of both the steel-making and support facilities on the site and a substantial discussion of the solid and hazardous waste generation, handling, treatment, storage, and disposal on the site. Slag material has been used as engineered fill at this facility (and at many other locations throughout the world) and is described in Section 3.2.3.4. Additional activities on the site including: permits, fires, spills, transformers, tanks, piping, inspections, compliance and previous investigations are described in Section 3.3 to 3.10. Section 3.0 presents an extensive body of knowledge concerning this site.

Section 4.0 provides an initial assessments of the available environmental data, site conditions, and potential for migration of contaminants at the site. Section 4.1 describes each of the SWMUs and the extent of contamination. In some instances, the data indicate releases are not potentially threatening to human health or the environment and U.S. Steel concludes that no further action is necessary at these SWMUs. In other SWMUs, the data are not adequate to reach this conclusion and further evaluation in the RFI will be needed. Section 4.2 and 4.3 of this report begin to assess the relative importance of potential migration pathways and the risk assessment model concept which appear at this time appropriate for the site. Sections 4.2 and 4.3 are based on all of the previous sections of the report and are useful in providing both an initial understanding of the site and in focusing the RFI.

2.0 INTRODUCTION

This report describes the environmental current conditions of the U.S. Steel Fairless Works in Fairless Hills, Pennsylvania, and has been prepared in accordance with the provisions of Attachment C (Resource Conservation and Recovery Act Facility Investigation Scope of Work Task 1), to the Final Administrative Order on Consent, U.S. Environmental Protection Agency (EPA) Docket Number: RCRA-III-065-CA, April 1993.

The Description of Current Conditions includes: 1) site background; 2) nature and extent of contamination found to date, including a description of potential areas of concern, and a summary of known contamination onsite and the existing degree and extent of the contamination; and 3) implemented interim measures. Attention to waste disposal and extent of contamination focused on Solid Waste Management Units (SWMUs), as described in the Draft Phase I RCRA Facility Assessment (RFA) report for the EPA, dated June 17, 1986.

Investigation methods included a detailed review of the investigations performed to date, discussions with U.S. Steel personnel on previous activities and plant processes, review of plant records, and site visits.

3.0 SITE BACKGROUND

3.1 SITE DESCRIPTION AND SETTING

3.1.1 Physiography

The U.S. Steel Fairless Works in Falls Township, Bucks County, Pennsylvania, is located on a broad alluvial plain of the Delaware River (Figure 1). At the plant site, the elevation of the plain is approximately 10 to 20 feet above mean sea level (MSL). A site topographic map is being submitted in conjunction with this report. The alluvial plain lies on the inside bend of a major change in the river channel direction from southeast to southwest. The change in direction corresponds to the emergence of the river from the undulating, rolling low relief hills of the Piedmont Physiographic Province to the relatively flat Atlantic Coastal Plain Province (Figure 2). In the northeastern United States, the boundary between these two provinces is commonly termed the "Fall Line" that trends northeast-southwest (NE-SW) and lies approximately 5 miles northwest of the site.

The Piedmont Province consists of a series of NE-SW trending uplands composed of rounded hills and plains cut by relatively narrow valleys. The altitude of the region ranges from 40 to 700 feet above MSL, with local relief not higher than 200 feet. The slope of the whole region is gradually to the southeast. The Piedmont Province is underlain by crystalline rocks of Pre-Cambrian and Cambrian age (Kimball, 1976).

The Atlantic Coastal Plain Province is a low-lying, gently rolling plain. In the Fairless Works area, the slope is generally to the southeast toward the Delaware River. The Coastal Plain is composed of unconsolidated or poorly consolidated, flat-lying sedimentary strata consisting of clay, silt, sandy clay, sand, and gravel of Mesozoic and Cenozoic age. The beds thicken to the southeast and overlie some of the consolidated crystalline rocks that are at or near the surface in the Piedmont Province.

3.1.2 Boundary Features

The U.S. Steel Fairless Works is located on the west bank of the Delaware River, approximately 1 mile west of Bordentown, New Jersey, 2 miles south of Trenton, New Jersey, and 3 miles east of Levittown, Pennsylvania (Figure 1).

The boundary area east and southeast of Fairless Works is low-lying wetlands, tidal marshes, and forested areas that represent former farmed fields. Bordering to the southwest and west of Fairless Works is the Geological Reclamation Operations and Waste Systems Inc. (G.R.O.W.S.) landfill, a subsidiary of Waste Management of Pennsylvania (WMPA). The northwest boundary of Fairless Works is the USX Industrial Park adjacent to the main gate of the facility and property belonging to Wheelabrator Environmental Systems, Inc. The boundary to the north is Tyburn Road. The low-lying, tidal marshes on and around Biles Island (owned by WMPA) are the northeast boundary of Fairless Works. The U.S. Steel facility and surrounding properties are shown on Figure 3. The "Site" under investigation consists of the facility plus borrow pits (BP) 21, 31, and 31A which extend onto a portion of the Wheelabrator property.

U.S Steel has granted rights-of-way across their property to Waste Management, the Philadelphia Electric Company, and the Public Service Electric and Gas Company. The locations of these rights-of-way are shown on Plate 18.

3.1.3 Adjacent Land Use

The land uses surrounding U.S. Steel Fairless Works are primarily commercial and industrial (Figure 4). The property bordering Fairless Works to the southwest and west is the currently active G.R.O.W.S. landfill. Land west of Fairless Works is currently owned by WMPA, as part of the G.R.O.W.S. Landfill. Also bordering to the west are the former National Can Corporation (property now owned by U.S. Steel) and the former American Can Company (now owned by K-Mart Corporation/Blue Chip Products). Both plants are currently inactive. Wheelabrator Environmental Systems is currently constructing a resource recovery plant on its property west of Fairless Works.

Land northwest of Fairless Works is occupied by businesses in the USX Industrial Park. USX Corporation owns three parcels in the industrial park. Other businesses in the industrial park include: Anvil Construction, Prefinish Priorcoated Metals, Morrisville Scrap Processing, Hooter Construction, and Hartwell Warehousing. The land north of Fairless Works and across Tyburn Road is owned by Penn Warner Co.

Northeast of Fairless Works is Biles Island, owned by WMPA. A portion of Biles Island was used for Delaware River dredge spoils disposal by the U.S. Army Corps of Engineers. WMPA presently has a permit issued by the Pennsylvania Department of Environmental Resources (PADER) to begin surface mining of sand and gravel from the dredge spoils disposed on the island.

The Delaware River forms the eastern and southern boundaries of the property.

3.1.4 Climate

The climate of the southeastern Coastal Plain and Piedmont Province in Pennsylvania is relatively moderate with long, and at times uncomfortably hot, summers, and mild winters. Daily temperatures reach 90° F or above an average of 25 days during the summer season; however, readings at 100° F or above are comparatively rare. From about July 1 to the middle of September, this area occasionally experiences uncomfortably warm periods, 4 to 7 days in length, during which light wind movement and high relative humidity make conditions oppressive. The prevailing wind direction during the summer months is from the southwest. The July mean maximum temperature is 88° F and the mean minimum temperature for the same month is 66° F. The winters in general are comparatively mild, with an average of less than 100 days with minimum temperatures below the freezing point. Temperatures 0° F or lower occur in the

Philadelphia area, an average of one winter in four. The freeze-free season averages 187 to 200 days. The mean maximum temperature for January is approximately 40 to 42° F and mean minimum temperature is 24° to 26° F.

Average annual precipitation in the area ranges from about 30 inches in the lower Susquehanna Valley to about 46 inches in Chester County. Under the influence of an occasional severe coastal storm, a normal month's rainfall may occur within a period of 48 hours. The average seasonal snowfall is about 30 inches and fields are ordinarily snow covered about one third of the time during the winter season. The mean annual precipitation for the local area is from 44 to 46 inches per year.

Records from the NOAA weather station at Neshaminy Falls, Pennsylvania indicate the following mean monthly temperatures and precipitation (NOAA, 1993):

Month	Mean Temperature 1992 (°F)	Mean Precipitation (inches)
January	30.6	3.37
February	32.4	3.11
March	36.6	4.38
April	50.4	3.80
May	58.6	3.86
June	68.7	3.65
July	74.3	4.92
August	70.9	5.28
September	64.7	4.10
October	51.0	3.36
November	45.4	3.88
December	36.0	3.74

The most important factor governing the regional climate is the moderating and moistening effect of the nearby Atlantic Ocean. However, the climate is also affected to a lesser extent by the eastward movement of storms across the continent, by cold air masses from the north, and by warm air masses from the south (Kimball, 1976). The soil survey report for Bucks and Philadelphia Counties describes the winds and air flow (SCS, 1975):

> Most of the weather systems that affect this area either develop in the midwest and are steered eastward by the prevailing westerly flow aloft, or they form in southeastern states and move northeastward parallel to the Atlantic Coast. . . . The prevailing wind is from the south-southwest and averages 8 miles per hour.

3.1.5 Regional Geology

The geology of the Atlantic Coastal Plain area is distinguished by the unconsolidated Quaternary and Cretaceous age sediments that lie upon a basement of early Paleozoic and older rocks of the Piedmont Province (Figure 5). The stratigraphic units in the vicinity of Fairless Works can be separated into four general groups: pre-Cretaceous crystalline basement rocks; late Cretaceous unconsolidated clays, sands, and gravels; Pleistocene sands and gravels; and recent river floodplain deposits (Figure 6).

3.1.5.1 Pre-Cretaceous

The basement rocks of the Piedmont Province are an assemblage of fine- to coarse-grained, crystalline, bonded, metamorphosed sedimentary and igneous rocks of the Glenarm Series. The rocks are divided into three distinct lithologies including a hornblende gneiss, granite gneiss, and a sequence of alternating micaceous schists and quartzite. In southeastern Pennsylvania, the basement rocks are predominantly micaceous and quartzose, and are assigned to the Wissahickon Formation. Cleavage and jointing are conspicuous and the color varies from yellowish gray to brownish black. Age dating of the Wissahickon Formation suggests that these rocks formed during the early Ordovician Period, at least 450 million years before present (Greenman, *et al.*, 1961).

The upper surface of the basement rock is frequently weathered to a residual soil (saprolite) that ranges in thickness from several feet to several tens of feet. The upper few feet are distinguished by a soft, gray, extremely micaceous clay that becomes firmer and more granular with increasing depth. The *in situ* weathered, micaceous, saprolitic clay will retain the fabric and structure of the parent rock (Wissahickon Formation). Beneath the partly disintegrated zone, the parent rock is a medium to coarsely crystalline, well foliated mica schist.

3.1.5.2 Cretaceous

A late Cretaceous unconsolidated sedimentary sequence rests unconformably on the crystalline basement rock. This sequence consists of layers of highly permeable sands and gravels alternating with low permeability silt and clay layers. The sedimentary sequence was formed primarily by nonmarine depositional processes. These deposits represent river channel, floodplain, and estuary sedimentation. The Cretaceous sediments are subdivided into the Raritan and Magothy Formations. The Raritan Formation is partially exposed in southeastern Bucks County while the Magothy is absent.

The Raritan Formation consists of alternating beds of nonmarine clay, sand, and gravel that occupy the stratigraphic interval between the consolidated pre-Cretaceous rocks below and the Magothy Formation above. The Raritan Formation can be readily distinguished from the overlying Magothy Formation on the basis of fauna and lithologic evidence.

In southeastern Pennsylvania, the Raritan Formation consists of a sequence of nonmarine deposits representing three cycles of sedimentation. Each cycle begins with a series of coarse detrital deposits and closes with a series of silts and clays. This sequence almost duplicates the section exposed in the type locality in New Jersey where the Raritan was subdivided into seven members. In ascending order, these members include the Raritan fire clay, the Farrington sand, the Woodbridge clay, the Sayreville sand, the South Amboy fire clay, the Old Bridge sand, and the Amboy stoneware clay. Each of these members can be correlated with equivalent units in Pennsylvania with the exception of the lower-most member, the Raritan fire clay, which is not easily recognized because the clay that occupies the same stratigraphic interval in the Pennsylvania section is believed to represent a residual clay (saprolite) derived from the mechanical disintegration of the underlying crystalline rocks. In this report the three clay members of the Raritan will be called, in ascending order, the lower, middle, and upper clay members. Therefore, in ascending order, the members of the Raritan formation in southeastern Pennsylvania are the Farrington sand, the lower clay, the Sayreville sand, the middle clay, the Old Bridge sand, and the upper clay. The correlation of the six members is based solely upon the similarities in texture and sequence of Raritan strata in Pennsylvania and New Jersey and does not necessarily mean that the individual strata can be traced as continuous lithologic units.

The Farrington sand member is the basal sand member of the Raritan Formation in southeastern Pennsylvania occupying the lowermost part of the pre-Cretaceous channels carved into the underlying crystalline rocks (Greenman, *et al.* 1961).

The Farrington sand member consists of predominantly coarse sand and fine gravel that grade upward into medium- to fine-grained sand containing a few beds of white clay. The color of the sand varies from yellowish gray to pale yellowish brown. Generally, the coarse sand and fine gravels are fairly well sorted but not as well sorted as the finer-grained materials (Greenman, *et al.*, 1961).

The thickness of the Farrington sand member differs greatly in southeastern Pennsylvania. The member is thickest in the axial parts of the troughs and thins rapidly toward the margins. The sand attains a maximum thickness of approximately 90 feet, but in most areas of occurrence in southeastern Pennsylvania, it rarely exceeds 60 feet in thickness (Greenman, *et al.*, 1961).

The lower clay member is composed mainly of a tough clay forming a nearly continuous bed of clayey material separating the underlying Farrington sand member from the overlying Sayreville sand member (Greenman, *et al.*, 1961). Generally, the lower clay occurs in the same bedrock channels as the Farrington sand member, but the distribution of the clay is somewhat different. Along the margins of the troughs the Farrington extends beyond the limits of the lower clay. The absence of the lower clay near the heads of the troughs indicates that it was subject to stream erosion immediately following the deposition of the clay. The tough clays are brick red in color in contrast to the gray color of the softer materials (Greenman, *et al.*, 1961).

The lower clay rests unconformably upon either the Farrington sand member or the residual clay (saprolite) of the crystalline rock. Similarly, the upper contact of the member is distinct where the clay is directly overlain by the Sayreville sand member of the Raritan (Greenman, *et al.*, 1961). The thickness of the lower clay differs from place to place due to the irregularities of the surface upon which it was deposited. For the most part, the thickness ranges between 20 and 40 feet.

The Sayreville sand member of the Raritan Formation consists of a sequence of light-colored, very fine- to coarse-grained sand beds and a few beds of light gray clay. The predominant color of the sand is pale yellowish-brown to orange. Most of the sediments are fairly well sorted and the grains are commonly subangular to subrounded. Characteristically, the nominal grain size decreases away from the heads of the depositional troughs, indicating the relative direction of movement of the depositing medium. Although the Sayreville is a persistent depositional unit, previous drilling logs give evidence that the sequence of beds is not altogether uniform from place to place. This suggests that the material was deposited in lens-shaped masses by shifting currents (Greenman, *et al.*, 1961). The thickness of the Sayreville sand member ranges from not present to a maximum of 49 feet. Generally the thickness is greatest near the axes of troughs in the underlying bedrock.

The middle clay is the most extensive clay member of the Raritan Formation in Pennsylvania. The upper surface of the clay is characterized by several elongated depressions oriented parallel to the trend of the underlying bedrock channels. Most of these irregularities are believed to be due to erosion that occurred contemporaneously with the deposition of younger deposits. A nearly uniform slope of approximately 40 feet per mile to the southeast is discernible where the surfaces of the clay are least channeled. This slope probably approximates the attitude of the strata composing this member.

The lithology of the middle clay is much less variable than that of other clay members of the Raritan Formation. For the most part, the middle clay member is composed of stiff, red and white clay with a uniformly massive texture. It commonly contains relatively little sandy material, but a few thin streaks or lenses of fine-grained sand have been noted, particularly in its middle and upper parts. Locally the base of the member is marked by a conspicuous bed of lignite. In general, the top and bottom of the clay in the subsurface can be identified readily from well logs except where the member lies directly upon other Raritan clays. In such places, it is difficult to distinguish the contacts because of the lithologic similarity of the individual clay members (Greenman *et al.*, 1961).

The thickness of the middle clay, similarly to that of the lowest clay, differs considerably from place to place owing to irregularities in the erosional surfaces that occur above and below the member. Within Southeastern Pennsylvania, the thickness commonly exceeds 20 feet and ranges from not present to about 60 feet (Greenman, *et al.*, 1961).

The Old Bridge sand member unconformably overlies the middle clay. Although it does not crop out at the surface in Pennsylvania, the Old Bridge sand underlies much of the Coastal Plain area in southeast Bucks County. For the most part, the Old Bridge occupies erosional depressions or scour channels in the underlying middle clay. Apparently the Old Bridge sand member was deposited by the same streams that scoured the channels in the clay; hence, it is assumed that erosion of the clay took place contemporaneously with the deposition of the sand. In a few localities, the underlying middle clay was completely removed and the Old Bridge was deposited directly upon deposits older than the middle clay (Greenman, *et al.*, 1961).

The Old Bridge sand member consists mainly of medium- to coarse-grained sand and contains minor amounts of fine to very fine sand. Beds of gravel are common, particularly at the base of the member. The predominant color is light gray to yellowish brown. In general, the material comprising the Old Bridge is fairly well sorted and individual grains appear to be angular or subangular (Greenman, *et al.*, 1961).

The thickness of the Old Bridge sand member is greatest along the axes of the depressions in which the sand accumulated. Away from these axes, the thickness gradually diminishes until the sand pinches out. It rarely exceeds 35 feet thick except near Turkey Hill in Bucks County, where as much as 100 feet of sand has tentatively been identified as Old Bridge (Greenman, *et al.*, 1961).

The upper clay is the uppermost member of the Raritan Formation. It is not an extensive deposit in Pennsylvania, but it does occur in the subsurface in a few localities in Bucks County. Where the upper clay is present in the subsurface, it overlies the Old Bridge sand member, separating the latter from the overlying Pleistocene deposits or from the Magothy Formation, if present.

The upper clay attains a thickness of 25 feet in Bucks County. It consists of light gray, more or less sandy clays; dark gray carbonaceous clays; and massive, red, white, and yellow clays (Greenman, *et al.*, 1961).

3.1.5.3 Quaternary

The Cretaceous sediments of the Coastal Plain of Pennsylvania are completely buried by Pleistocene deposits consisting of sand, gravel, and clay. Lockwood and Meisler (1960) subdivided the Pleistocene in the Coastal Plain of Bucks County into Wisconsin and Illinoian stages, which are separated by a period of weathering and erosion corresponding to the Sangamon interglacial stage (Greenman, *et al.*, 1961).

In Bucks County, the maximum thickness of the Pleistocene deposits is about 60 feet, while the typical thickness is approximately 30 feet. The older, Illinoian-age sediments are intensely weathered compared to the Wisconsin sediments. Glacial erratics (boulders) weighing as much as several hundred pounds are found in the Illinoian in the Morrisville area. Some of the boulders have flattened solelike surfaces on which faint glacial striations are common. The deposits of Wisconsin age consist of poorly sorted, gray sand and gravel comprising material ranging in size from fine-grained sand to glacial erratics weighing several hundred pounds of diverse lithologies. Many of the boulders in the Wisconsin are also soled and show strong glacial striations (Greenman, *et al.*, 1961).

3.1.5.4 Recent

Recent floodplain deposits consist of organic, dark gray mud, silt, and fine sands that underlie the channels and tidal flats of the Delaware River and its principal tributaries. The recent sediments occur as a thin veneer of fine-grained material that overlies other deposits. In some cases, these materials form a confining bed over the Pleistocene deposits.

3.1.6 Regional Hydrogeology

In the Atlantic Coastal Plain of Pennsylvania, the largest supplies of groundwater occur in the unconsolidated deposits of Cretaceous and Pleistocene age. The underlying crystalline rocks are a relatively unimportant source of groundwater except further to the west adjacent to the Fall Line where the unconsolidated deposits are thin or absent (Greenman, *et al.*, 1961).

3.1.6.1 Crystalline Rocks

The crystalline rocks include a variety of rock types that have little if any effect upon their water-bearing properties. All are dense, crystalline rocks that, in their unaltered state, are virtually impervious to water. However, like most consolidated rock formations, they are broken by joints and other fractures as a result of weathering and deformation. These openings constitute only a small part of the total rock volume, but they provide for the storage and movement of considerable quantities of water.

The openings that contain groundwater are most abundant in a relatively shallow zone of rock material near the land surface where weathering is most effective. Beneath this zone, the number and size of such openings decrease rapidly as the weathered material grades into unaltered rock. The weathered zone is thickest in areas of low to moderate relief and is thin or absent in areas of high relief. The weathered zone apparently rarely extends below a depth of about 150 feet because the yields of wells are seldom increased by drilling below that depth. A few wells, however, are reported to obtain appreciable amounts of water below depths of 150 feet (Greenman, *et al.*, 1961).

Based on the records of drilled wells (Greenman, *et al.*, 1961) in the Coastal Plain area, the crystalline rocks are a reliable source of small to moderate supplies of groundwater. The reported yields of 74 wells range from 1 to 350 gallons per minute (gpm) and average 65 gpm. The specific capacity of wells tapping these rocks, based on data from 42 wells, ranges from 1 to 8 gpm per foot of drawdown and averages 3 gpm per foot of drawdown.

In the outcrop area of the crystalline rocks, groundwater generally occurs under water-table conditions. Locally, water under artesian conditions may be expected in areas where open fractures in the crystalline rocks occur beneath the weathered zone and impermeable confining beds of the overlying sediments.

The residual clay (saprolite) at the top of the crystalline rocks probably serves as a confining bed below the overlying unconsolidated sediments. This is evident from available water-level data that show a difference in head between water in the crystalline rocks and that in the unconsolidated material immediately above the contact. Where the confining bed is continuous, the head in the crystalline rocks has a relatively steep gradient to the southeast away from the Fall Line. The gradient is interrupted wherever the confining bed is breached and, where this occurs, the head in the crystalline rocks and the unconsolidated aquifers is about the same.

3.1.6.2 Unconsolidated Sediments

In southeastern Bucks County, the Sayreville sand member is not completely isolated from other aquifers because the overlying clay bed is replaced in a few places by the Old Bridge sand member and younger channel-fill deposits of Pleistocene age. Where the channel fills occur, the Sayreville member is presumed to be hydraulically continuous with overlying water-bearing beds with which it probably functions as a single hydrologic unit. The water-bearing properties of the Sayreville sand member are imperfectly known, chiefly because it is tapped by only a few wells in the Coastal Plain Area. Comparison of the Sayreville sand member with the Farrington sand reveals that the average permeability of the members is about the same; however, the average transmissibility of the Sayreville member probably is less than that of the Farrington member because the average thickness of the Sayreville is less than that of the Farrington.

The middle clay has an extremely low permeability and serves as an effective barrier to the movement of groundwater. In Bucks County, it contributes to artesian conditions in the underlying Sayreville sand member.

The Old Bridge sand is sufficiently porous and permeable to store and transmit considerable quantities of groundwater. It is not a distinct hydrologic unit in the Coastal Plain of southeastern Pennsylvania. Throughout most of the area of occurrence, it forms a hydraulically continuous unit with overlying deposits of sand and gravel of Pleistocene age, essentially functioning as a single aquifer.

The upper clay is not an important hydrologic unit in southeastern Pennsylvania because of its small areal extent. Where present, it contributes to local artesian conditions in the underlying Old Bridge sand separating it from the overlying sands and gravel of Pleistocene age.

The Pleistocene deposits, together with the underlying Old Bridge Sand member of the Raritan formation, comprise the most extensive aquifer in the lower Delaware River Valley in Pennsylvania. The Pleistocene deposits are extremely heterogeneous, consisting of a wide assortment of grain sizes including considerable amounts of fine-grained clayey material. As a result, the water-bearing properties of the aquifer are far from uniform. In general, the best water-bearing materials in the aquifer occur along the Delaware River in southeastern Bucks County where the sands and gravels near the base of the Pleistocene section are fairly well sorted.

The reported yields of 61 wells tapping the Pleistocene deposits in the Coastal Plain area have an almost meaningless range of values: from 8 gpm to 7,000 gpm. The specific capacities of 30 wells for which test data are available range from 2 gpm per foot of drawdown to 65 gpm per foot of drawdown, with a mean of 21 gpm per foot of drawdown. The highest specific capacities are recorded for wells that are located adjacent to sources of surface recharge. This indicates the relative importance of induced recharge to the sustained yield of this aquifer.

Artesian conditions occur where the Pleistocene deposits are overlain by younger sediments (Recent alluvium) that are less permeable, acting as a confining bed for the Pleistocene aquifer.

3.1.7 Site-Specific Geology

The site-specific geology at Fairless Works can be divided into four parts for this discussion. These include:

- Crystalline Bedrock (pre-Cretaceous)
- Lower Raritan Formation (Cretaceous)
- Upper Raritan Formation - confining clay units (Cretaceous)
- Alluvial deposits and Pleistocene sands and gravels

3.1.7.1 Crystalline Bedrock

The bedrock at Fairless Works consists of mica and hornblende schists and gneisses. Bedrock surface contours (Greenman *et al.*, 1961) range from 100 to 160 feet below MSL. These contours are based on relatively few data points. Borings inside the G.R.O.W.S. Landfill area west of Fairless Works encountered bedrock at elevations ranging from approximately 150 to 130 feet below MSL. The lack of deep borings at Fairless Works limits a definitive bedrock contour at the site.

3.1.7.2 Lower Raritan Formation

Farrington Sand - Lower Clay - Sayreville Sand Members

The number of borings penetrating the Lower Raritan Formation, specifically the Farrington sand and lower clay members, is limited. The lower limit of the Farrington sand is approximately 150 feet below MSL (Greenman, *et al.*, 1961). The Farrington sand is identified as ranging from an upper limit depth of 110 feet to 150 feet below MSL. Generally, the Farrington sand is logged as a gray to brown sand in many of the borings.

The lower clay member is a confining layer between the Sayreville sand and the Farrington sand. The lower clay was penetrated at depths ranging from 80 feet to 120 feet below MSL. The lower clay is described as a red and white clay, sometimes mottled with lenses of silt and sand.

The Sayreville sand member at Fairless Works ranges from 50 feet to 80 feet below MSL. From the borings previously completed at the site, the Sayreville is described as a brown, tan, gray sand with lenses of gray clay and gravel. Hydrogeologically, this unit forms an aquifer.

3.1.7.3 Upper Raritan Formation

Middle Clay - Old Bridge Sand - Upper Clay Members

The middle clay is a confining layer at the site separating the Old Bridge sand member and Sayreville sand member. The middle clay, as described in the boring logs, is a red and white clay with mottling. Generally, the depth of the clay ranges from 30 feet to 60 feet below MSL.

The Old Bridge sand member is described at Fairless Works as a brown, gray sand with lenses of gravel, silt, and clay. Generally, the Old Bridge sand ranges from 20 feet to 40 feet below MSL at the site. This unit is the second shallowest aquifer onsite with hydrogeologic characteristics capable of storing and transmitting considerable quantities of groundwater. It has not been confirmed if the aquifer is a distinct hydrogeologic unit or forms a hydraulically continuous unit with overlying deposits of the Pleistocene.

The upper clay beneath Fairless Works is a confining layer between the Pleistocene age deposits and the Old Bridge sand member. The upper clay is described from the boring logs as a gray clay with sand and red, white, and yellow (tan) clay. The upper limit of the upper clay ranges from 10 feet to 30 feet below MSL.

3.1.7.4 Recent and Pleistocene Deposits

Pleistocene deposits at Fairless Works have been penetrated by numerous monitoring wells. The Pleistocene deposits are described primarily as brown and gray sand, gravel, and clay. The Pleistocene deposits form the shallowest and most extensive aquifer onsite. The upper limit of the deposits range from 20 feet above to 30 feet below MSL. The deposits as described above are extremely heterogeneous, thus the water-bearing properties of the aquifer are far from uniform. As described in Greenman (1961), the best water-bearing materials in the aquifer occur along the Delaware River in southeastern Bucks County (including Fairless Works) where the sands and gravels are fairly well sorted.

3.1.8 Surface Hydrology

Precipitation in southeastern Pennsylvania may run off, infiltrate, or be recycled to the atmosphere via evapotranspiration. Runoff in the local area drains primarily into the Delaware River either naturally or through the storm water system.

Prior to development of Fairless Works in the early 1950s, the site had been used for agricultural purposes. Generally, the site drainage flows south to the Delaware River. The location of predevelopment historic drainage channels are illustrated in Figure 7.

An extensive storm water system drains surface runoff throughout Fairless Works (Figure 7 and Plate 3). The storm water system consists of three drainage canals that traverse the study area in a north-south direction, draining through permitted outfalls to the Delaware River. The wire mill area discharges storm water directly to a small arm of the Delaware River, south of the mill. The pipe mill, sheet and tin mill, bar mill, and rod mill areas discharge storm water through the East Canal to the Delaware River. Storm water runoff from the sheet and tin mill area, administration area, central shops area, and rolling mill area discharges to the Central Canal. The Central Canal discharges to the Delaware River east of the Terminal Treatment Plant. Storm water runoff from the open hearth furnace area and the coke and coal chemical plant drain into impoundments west of these areas. The impoundments drain into the West Canal, which discharges to the boat slip and to the Delaware River.

3.1.8.1 Wetlands

Historical aerial photography (Figure 8) for Fairless Works site prior to 1952 indicates that nearly the entire property was used for agricultural purposes. Very limited areas along creek beds may have been wetlands at that time.

More recent reviews of the site indicate that wetlands areas are located at the plant site at various locations (Figure 7). The accuracy of the wetlands mapping performed in 1977, that is shown in Figure 7 is suspect, however, since several areas that are shown as wetlands contained facility structures for several years prior to the date of the map. Wetlands areas are present along the Fairless Works shoreline boundary with the Delaware River. Some undeveloped areas at the plant site that are relatively flat and low lying are also wetlands. (Generally, these wetlands are located in the southern area of the plant, approximately 2,000 feet north of the Delaware River.) Wetlands are located near historical drainage runs throughout the plant site (Golder Associates, 1988). During construction of Fairless Works, a number of borrow pits were excavated to provide fill material to raise the elevation of production facilities above the floodplain. Some wetlands characteristics may have developed in some of these industrial pits after their construction. An intermediate level delineation of Permitted Slag Disposal Areas A (BP 28-A and 28-B) and B (NT-1 and NT-2) was performed in 1990 (Keystone Environmental Resources, 1990). The following summary is taken from this delineation report:

> "Both areas under investigation were found to contain wetlands. These wetlands are not dominated by obligate plants, but have enough dominant FACW and FAC plants and hydrologic and soil characteristics to be considered wetlands. These wetlands are of rather low importance due to their location, lack of obligate plants, and minimal wildlife usage. They contribute little to the habitat and diversity of the local flora and fauna."

3.1.8.2 Biles Creek

Biles Creek, a natural boundary between Biles Island and Fairless Works, is a tidal creek and a meander loop of the Delaware River. Biles Creek receives small amounts of storm water runoff from the plant area. Some storm water runoff drains into the creek from Biles Island, which is owned by WMPA. The channel dimensions remain fairly uniform in the southern section and narrow to the north. The creek is blocked near the access road interchange, impeding flow from the northern channel to the southern channel. Since Biles Creek is not gaged, the flow rate is not available.

3.1.8.3 Floodplain

The 100-year floodplain areas at Fairless Works are generally located along the Delaware River (Figure 9). The 100-year floodplain follows the Biles Creek shoreline bordering the plant. Floodplain areas have also been identified inside the plant boundaries north and west of the Delaware River.

3.1.8.4 Delaware River

The Delaware River drains a large area in New York, New Jersey, and Pennsylvania prior to reaching the study area. The Delaware River is tidally influenced as far as Trenton Falls, approximately 8 miles upstream from Fairless Works. The mean water level at Bordentown, New Jersey (directly across the river from the site) is 3.5 feet above mean sea level and the mean tidal range is 6.7 feet (NOAA, 1992). The river water is still fresh at Fairless Works site. The river ranges from 1,000 feet to 2,000 feet wide and a dredged channel bottom is maintained to a depth of 40 feet. The long-term average Delaware River flow rate at Trenton, New Jersey, is 11,660 cubic feet of water per second (CFS) (USGS, 1992).

3.1.9 Soils

The Fairless Works property is underlain by the following soils: Urban land, Urban land-Howell Complex, Pope loam (terrace), Fallsington silt loam, Alton gravely loam, and Marsh (Figure 10).

Urban land is the predominant soil found at Fairless Works. Most Urban land is on terraces of the uplands and Coastal Plain; however, some is present on the floodplain. Generally areas are irregular in shape and 5 to 1,000 acres or more in size. The soils and foundation materials are highly variable. Most areas have been leveled and the original soil material has been disturbed, filled over, or otherwise destroyed prior to construction. Industrial structures cover much of the land surface at Fairless Works, making identification of the soils impractical.

The Urban land-Howell Complex is the second predominant soil in areal extent at Fairless Works. This complex is 60 percent Urban land, 35 percent Howell silt loam, and 5 percent included soils. It is in semi-builtup areas on terraces of the Coastal Plain. Areas are irregular in shape and range from 5 to 3,000 acres or more in size.

The Howell silt loam is found on 0 to 3 percent slopes. This soil is on broad, uniform sides of terraces on the Coastal Plain. Areas are irregular in shape and 3 to 20 acres in size. The profile of soil is a surface layer of dark brown and dark grayish brown silt loam greater than 9 inches thick. The subsoil is greater than 33 inches thick. Generally, the upper 20 inches is strong brown, silty clay loam and clay loam and the lower 15 inches is strong brown, sandy clay loam and gravely-clay loam that extends to a depth of 50 inches.

The Pope loam (terrace) is found on 0 to 3 percent slopes. This soil is mainly on broad low terraces in the Delaware River Valley. It lies above the present level of flooding. Areas are irregular and 3 to 50 acres in size. The Pope loam (terrace), is found in the northeast corner at Fairless Works bordering on the Delaware River. The Pope loam (terrace) is derived from weathered shale, sandstone, quartz, and limestone. A representative profile of the Pope loam (terrace) shows the plow layer is a dark brown loam about 10 inches thick. The subsoil is 39 inches thick. The upper 13 inches is brown loam and very fine sandy loam. The lower 26 inches is brown and dark yellowish brown fine sandy loam. The substratum is dark yellowish brown and dark grayish brown, very gravely loamy sand and gravely sand that extends to a depth of 80 inches.

The Fallsington silt loam, gravely subsoil variant is found on the southern end of Biles Island. Most of this soil is in slight depressions and at the base of low slopes. Areas are irregular in shape and 3 to 10 acres in size. The soil is used for pasture or woodland, or it is idle. The soil generally is wet and poorly suited to crops. A representative profile of the soil in a wooded area includes: 2 inches of organic material covering the surface, a grayish brown silt loam surface layer about 7 inches thick, and the subsoil, about 43 inches thick. The upper 8 inches of the subsoil is light gray and very pale brown gravely silt loam and gravely silty clay loam that has predominant, strong brown, yellowish red, and white mottles. The next 20 inches is gray gravely sandy clay loam that has distinct, light gray, reddish yellow, brown, and white mottles. The lower 15 inches is strong brown, mottled gravely sandy clay loam.

3.1.10 Water Supply and Monitoring Wells

3.1.10.1 Water Supply Wells

Fairless Works had two water supply wells. These wells, identified by Golder Associates (1988) (Figure 11), were collector wells that used horizontal screen sections draining to a central caisson. Water was then pumped from the central caisson for plant uses. These wells were constructed in 1952 for industrial uses with yields of 7,000 gpm and 4,000 gpm, respectively. Current plant water supplies are pumped directly from the Delaware River either through an intake referred to as "C" well or other river intakes. Therefore, the two production wells are no longer in use.

3.1.10.2 Monitoring Wells

Records of monitoring wells installed at Fairless Works are identified in Table 1. Monitoring wells have been installed from 1980 through 1992 for previous environmental investigations (Figure 11). The smallest of the monitoring wells are constructed with 1-inch internal diameter (ID) polyvinyl chloride (PVC). The screens, generally measuring 5 to 10 feet in length, were set at the bottom of the borings. Filter material consists of either No. 1 or No. 2 sands or pea gravel for the wells. A bentonite seal was placed on top of the filter pack. Generally, the remaining well annulus for each of these monitoring wells was either grouted or grouted and backfilled.

The monitoring wells at Fairless Works are predominantly screened in two aquifers, the Pleistocene deposit aquifer and the Old Bridge sand member. Generally these wells are approximately 40 feet or less in depth and are screened in aquifers that underlie confining beds. Many of the wells installed under these conditions are artesian.

The monitoring wells installed at Fairless Works have the dual purposes of providing groundwater elevation data and being sampling points for evaluating groundwater quality. The monitoring wells provide information defining aquifer characteristics and seasonal variance of groundwater levels for each aquifer. Previous studies (Chester, 1981 and Golder, 1988) have shown that the depth to groundwater ranges from approximately 5 to approximately 20 feet below the ground surface. Groundwater levels dropped approximately three feet between August 1980 and January 1981 (Chester, 1981). Hydraulic conductivity in the upper aquifer ranged over several orders of magnitude from 10^{-1} to 10^{-5} cm/sec (Golder, 1988). Hydraulic gradients were generally radial towards the Delaware River (Golder, 1988)

In previous environmental investigations, chemical analyses of groundwater provided information on chemical constituents and extent of contamination. Generally, groundwater has been sampled for inorganics (metals), acid extractable/base neutrals (semivolatile organics), volatile organics, pesticides/PCBs, total cyanide, and total phenols.

3.1.11 NPDES Outfalls

Fairless Works had nine identified outfalls that discharged to the Delaware River (Figure 12). Six of these outfalls are listed in the current NPDES Permit (No. PA 0013463, December 1990) as follows:

002	East Canal Outfall
003	Central Canal Outfall
004	Powerhouse Outfall
005	Blast Furnace Outfall
007	West Canal Outfall
009	Wire Mill Outfall (storm water only)

In addition, outfalls within the plant (102, 103, 105, 203, 303, 403, etc.) that ultimately discharge to these 6 outfalls are listed in the NPDES permit. The remaining three outfalls that discharged to the Delaware River are listed below:

001	North Canal Outfall (USX Realty NPDES Permit)
006	Sinter Plant Outfall (plugged)
008	Sedimentation Basin Drain Outfall (not in use)

Storm water is still discharged at all outfalls except 006 and 008. The locations of all outfalls are shown in Figure 12. The NPDES monitoring at each outfall is summarized in Table 2.

The East Canal (Outfall 002) presently receives effluent from storm water, process water, and noncontact cooling water discharges by way of the pipe mill, the sheet and tin mill, bar mill, and rod mill. During rod mill and electric furnace operations (prior to 1983), effluent from the rod mill settling lagoon was discharged into the East Canal through NPDES Outfall 102. Outfall 002 is monitored for flow rate, temperature, oil and grease, pH, first stage oxygen demand (FSOD), and BOD_5.

The Central Canal (Outfall 003) traverses the central area of Fairless Works west of the general office and slab mill, and east of the open hearth furnace. Water from the strip mill and slab mill was discharged through Outfall 303 as noncontact cooling water, intermittent slab spray cooling water, and storm water runoff to the upper Central Canal prior to August 1991. Water at Outfall 303 is monitored for flow rate, BOD_5, FSOD, total suspended solids, oil and grease, pH, and temperature. Wastewater from the sanitary sewage plant is discharged to the Central Canal through Outfall 203, north of Outfall 103, and into the Delaware River at Outfall 003. Outfall 203 is monitored for flow, temperature, BOD_5, FSOD, total suspended solids, fecal coliform, and pH.

Storm water runoff and condenser cooling water from the onsite power house is discharged at Outfall 004. Outfall 004 is monitored for flow rate, temperature, pH, BOD_5, and FSOD.

Cooling water, process water, and storm water runoff from the blast furnaces (prior to 1991 shutdown) were discharged to Outfall 005. Outfall 005 was monitored for flow rate, temperature, pH, total suspended solids, BOD_5, FSOD, total silver, total zinc, and total phenols. The blast furnace wastewater recycle system discharged water from Outfall 105 to Outfall 005. Outfall 105 was monitored for flow rate, total suspended solids, pH, ammonia, cyanide, total phenols, total lead, and total zinc.

The sinter plant outfall (Outfall 006) was plugged in 1985. Water originally discharged through this outfall was diverted to Outfall 103.

The West Canal traverses an area west of the coke plant on U.S. Steel property. The West Canal discharges water to Outfall 007 at the boat slip on the Delaware River. The West Canal received discharges of cooling water and storm water runoff from the coke plant (prior to 1984 shutdown) and open hearth furnace (prior to 1991 shutdown). Effluent from Outfall 007 was monitored for flow rate, temperature, and pH.

The current NPDES permit only allows storm water runoff and/or groundwater infiltration to be discharged at Outfall 009 to the Delaware River. No floating solids or visible foam in other than trace amounts are allowed to discharge from this outfall.

The three outfalls not listed in the current NPDES permit are Outfalls 001, 006, and 008. The North Canal (Outfall 001) receives effluent from the USX Realty Sanitary Sewage Plant. The Sanitary Sewage Plant is operated by USX Realty under NPDES Permit No. PA0052701 and serves the industrial park. Sampling of the outfall was not required after 1986 for the U.S. Steel NPDES permit (No. PA 0013463). Outfall 006 was plugged and is no longer in use. Water discharged to Outfall 008 was from the Delaware River intake sedimentation collection basins. This outfall is no longer in use.

3.2 HISTORICAL USE OF THE SITE

3.2.1 Ownership and Operations

Prior to 1952, the site was used for agricultural purposes (see Figure 8). At that time, the property was relatively low in elevation and sloped gently south and west. A series of channels carried surface runoff south to the Delaware River. A cannery once operated on the site, located approximately where the bar mill now stands.

During construction of Fairless Works, numerous borrow pits were excavated to provide fill material to raise the main facility site above the elevation of the 100-year floodplain.

The plant began operations in 1952. Its primary activities were integrated steel-making and finishing. The majority of the facilities were constructed in the early 1950s. Additional development took place in the late 1960s and early 1970s, including the construction of the electric arc furnace, rod mill, and wire mill.

When fully operational, Fairless Works consisted of the following major facilities:

- Coke and Coal Chemical Plant
- Sinter Plant
- Blast Furnaces
- Open Hearth Furnaces
- Electric Arc Furnace
- Primary Mills
- Hot Strip Mill

- Sheet and Tin Mills
- Bar Mill
- Rod Mill
- Pipe Mill
- Wire Mill
- Power House
- Maintenance Facilities
- Wastewater Treatment Plants

In the early 1980s, the electric arc furnace and several finishing operations (rod, bar, rolling, and wire mills) were shut down. In 1984, the coke and coal chemical plant was shut down. The sinter plant ceased operations in 1990. Steel-making operations ceased in 1991 when the last blast furnace, open hearths, and primary mills were shut down. Currently, only the finishing facility - the sheet and tin mill - is still operating. A portion of the wire mill building is being used by Crown, Cork & Seal, Inc.; the pipe mill is being operated under lease to LaClede Steel Co.; and a portion of the bar mill warehouse is being operated under lease by Chicago Steel Inc.

As part of the redevelopment of the site for future industrial use, demolition of inactive facilities is occurring. Demolition plans include the removal of aboveground structures only, no soils are expected to be excavated. Basements, sumps, and tunnels will be filled to grade. Demolition debris is being handled in accordance with state and federal regulations. Areas to be demolished are shown in Figure 13. The current schedule of demolition is as follows:

Coke Plant Area	June 1992 through December 1993
Sinter Plant	July 1992 through August 1993
Blast Furnace	July 1992 through September 1993
Electric Furnace	July 1992 through June 1994
Open Hearth	July 1992 through February 1995
Rolling, including:	July 1992 through October 1995
Rod/Bar/Bloom/Slab mills	
Soaking Pits, Stripper	

3.2.2 Integrated Steel Plant Operations

U.S. Steel Fairless Works was an integrated steel-making operation with the following facilities: coke plant, sinter plant, blast furnaces, open hearth furnaces, electric arc furnace, slab and billet mill, hot strip mill, sheet and tin mill, pipe mill, bar mill, rod mill, and wire mill. Currently, the sheet and tin mill is the only U.S. Steel-owned operating mill at the facility. The other steel-making and finishing mill facilities have been shut down at various times through the 1980s to 1991. The approximate shut down dates are as follows: Electric Furnace and Caster, 1980; Wire Mill, 1983; Rod Mill, 1983; Blast Furnace No. 1, 1983; Bar Mill, 1984; Coke Works, 1984; Sinter Plant, 1990; Billet Mill, 1989; Blast Furnace No. 2, 1989; Blast Furnace No. 3, 1991; Slab and Hot Strip Mills, 1991; and Open Hearth Furnace, 1991. Some buildings and areas have subsequently been leased for other uses unrelated to steel making.

3.2.2.1 Coke Plant Operations

The coke plant operations at Fairless Works supplied the coke necessary for the production of iron in the blast furnaces. The coke plant was a byproduct plant that produced coke oven gas, coal tar, crude light oils, ammonium sulfate, and naphthalene in addition to coke.

In the operation of the plant, production began with the charging of the coke oven with bituminous coal. The coke ovens consisted of two batteries, each containing 87 ovens that were 18 inches wide and 12 feet 2 inches high. The batteries were built in 1953 and were shut down in 1984. The ovens were heated by burning coke oven gas in flues between the walls of the adjacent ovens.

During the coking period, the gases and volatile materials distilled from the coal traveled through ascension pipes and into the collection main that ran the length of the battery. At the end of the coking period, the doors were removed from each end of the oven and the ram on the pushing machine pushed the coke into the quenching car. The coke was then cooled by water sprays in the quenching tower, screened and conveyed to the blast furnaces.

In the collecting main, the gas produced during the coking process was cooled by water sprays with flushing liquor (water). In the initial cooling process, heavy tar was condensed out of the gas, and liquor/tar flowed to a flushing liquor decanter where the tar was separated and recovered. The liquor was recycled to the collecting main sprays.

The gas was drawn through primary coolers where the lighter tars were condensed. The condensed tar and liquor flowed to a circulating liquor decanter where the tar was separated and recovered. The liquor was dephenolized, stripped of the ammonia, and returned to the primary coolers for further cooling. The treated excess liquor (primary cooler liquor) was used as makeup to cool the gas in the collector main, flush the collecting main, and as makeup to the quenching tower as required.

Following the primary coolers, the gas passed through turbine driven exhausters that pulled the coke oven gas, under suction, from the collection main and forced it under pressure through the remaining byproduct plant equipment. The gas then passed through tar reheaters and extractors where entrained tar and ammonia liquor were separated and returned to the circulating liquor decanter.

The ammonia absorber followed the tar extractors. The coke oven gas passed through a spray type absorber where a dilute solution of sulfuric acid was sprayed countercurrent to the gas to remove the ammonia in the form of ammonium sulfate. The concentrated ammonium liquor leaving the absorber was pumped to a crystallizer section where crystallization took place by the combined cooling and concentration effects of vacuum evaporation. The ammonium sulfate crystals were formed and removed as product.

Following the ammonia absorber, the gas passed through the final coolers where the coke oven gas was cooled by direct contact with cooling water. The water from the final cooler flowed to a naphthalene skimming basin where insoluble naphthalene was recovered. The water was cooled and recycled to the final coolers.

From the final cooler, the gas passed through light oil scrubbers that removed the crude light oils by an absorbent known as wash oil. Following the gas scrubbers, the light oils were stripped from the wash oil by steam distillation. The wash oil was then cooled and recirculated to the light oil scrubbers. The vapors leaving the wash oil still were condensed in the light oil condenser and then flowed to the light oil decanter where light oil and condensed water were separated. The water separated from the light oil was returned as makeup to the decanters.

After the coke oven gas left the light oil scrubbers, about 40 percent of the gas produced by the coking process was returned to underfire the batteries. The remaining gas was boosted in pressure and used as fuel for other mill operations. Based on current operations at other plants, this gas consists dominantly of hydrogen and methane. Table 3 shows the components of typical coke oven gas.

3.2.2.2 Sinter Plant Operations

Iron ore sinter was produced for blast furnace use at Fairless Works on two sinter strands (No. 1 and No. 2 lines) at the Fairless sinter plant. The No. 1 sinter line was commissioned in 1956 and continued to operate through December 1982, while the No. 2 line was started up in 1960 and operated through May 1990. The No. 1 sinter strand consisted of 129 pallets, each 8 ft wide and 3.5 ft long, attached one to the next into a continuous loop or traveling grate. Each pallet was outfitted with a number of 2-inch-wide grate bars. The No. 2 sinter strand was shorter, consisting of 118 pallets of the same size as those found on No. 1 line (effective grate area of 1,344 ft^2). Each pallet also was outfitted with pallet rollers or wheels to support the pallets on the rail used to guide their movement.

At the sinter plant, a number of fine (3/8-in.) materials containing iron, fluxes (CaO and MgO), and carbon were mixed together with undersized (<1/4-in.) sinter (hot and cold fines or recycled) along with added water in a mixing drum to promote mix aggregation. Iron-bearing materials included iron-ore fines and concentrates, scale, and iron-making and steel-making slag fines. Flux-bearing materials included limestone and/or dolomite fines and steel-making slag fines. Carbon-bearing materials (fuels) included anthracite coal and/or coke fines (breeze) and blast furnace flue dust.

After mixing, the sinter mix was conveyed to a receiving hopper above the feed end of the continuously-moving traveling grate of the sinter strand. A 1- to 1½-inch layer of sized sinter (hearth layer) was placed on the sinter strand to protect it from excessive temperatures, and then the sinter mix was fed on top of the hearth layer to a depth of about 14 inches. The movement of the traveling grate caused the bed of material to pass under an ignition hood containing natural gas burners where the top of the sinter bed was ignited. The air passing through the bed of material as a result of the induced draft fan (265,000 scfm) caused the burning zone to pass down through the bed of materials as the traveling grate continued to move toward the discharge end of the strand. After passing through the bed, the air, now laden with dust and moisture, passed through windboxes under the grate into downcomes, which connected the windboxes with the off-gas main, and then into the off-gas main itself. The propagation of the burning zone (heat and ignition fronts) caused the following to happen in the sinter bed: evaporation of moisture, calcination of limestone and dolomite, and sintering (incipient fusion) of the individual raw-material particles, with attendant chemical reactions causing the formation of bonding phases such as calcium and magnesium ferrites and calcium silicates. The speed of the traveling grate was adjusted such that the burning zone reached the top of the hearth layer near the discharge end of the sinter strand.

Two gas-cleaning systems were employed at the Fairless sinter plant, one for the windbox or sinter plant off-gas, and one for dust generated at the discharge end of the sinter machine and at the hot screen. The windbox gases were dedusted with dry multiclones (multiple cyclones), located upstream from the induced draft fan, and then passed out the off-gas stack. The air evacuated from the machine discharge and hot screen areas was cleaned with Roto-Clone low-energy wet scrubbers.

3.2.2.3 Blast Furnace Operations

Molten iron for use in steel-making was produced at Fairless Works in Blast Furnaces No. 1, No. 2, and No. 3. The blast furnaces were vertical cylindrical structures approximately 105 feet in height and 30 feet in diameter. Blast Furnace No. 1 was 29 feet, 6 inches in diameter and had a maximum production of 2,900 tons/days of iron. This furnace was shut down in 1983. Blast Furnaces No. 2 and No. 3 were both 30 feet, 10 inches in diameter and each had a maximum production of 3,900 tons/day of iron. No. 2 was shut down in 1989, No. 3 in 1991.

The blast furnace is basically a large chemical reactor in which iron ore was reduced and smelted to make liquid pig iron. Lump iron ore, iron ore agglomerates, and revert materials were sources for iron oxide and/or metallic iron. Limestone, dolomite and steel-making slag were fluxing agents. The raw materials for the process, iron ore, coke, and limestone were stored in bins in the stockhouse. They were withdrawn from the bins, weighed and carried to the top of the furnace by a skip car. The raw materials were charged into the furnace through a two-bell top arrangement that permitted the solids to enter the furnace while preventing gas from escaping. The material was preheated by the upward moving gases as it descended through the stack of the furnace. The iron oxides were reduced by reacting with the CO and H_2 in the gas which removed the oxygen from the oxide. Near the bottom of the blast furnace, the iron melted and was collected in the hearth. Other materials such as silica and alumina in the ore and the coke ash were also melted and combined with the fluxing agents to form a liquid slag which also collected in the hearth of the furnace. Slag, being lighter than iron, floated on the top of the iron. Periodically, usually every two to four hours, the furnace hearth was tapped and the liquid iron and slag were removed. In the cast house, the slag was skimmed off the top of the iron as it flowed from the furnace and drained into open pits. The molten iron was collected in hot-metal torpedo cars and transferred to the desulfurization station or to the open hearth.

The energy required by the process was generated by burning the coke with hot air introduced near the bottom of the furnace through openings called tuyeres. The air, sometimes called cold blast, was compressed in one of four large compressors or blown through a stove to preheat the air. The stoves were large cylindrical vessels that contained ceramic checkers that were used to transfer heat to the cold blast. These stoves were regenerative types in which one stove was preheated by burning gas and air and the other stove was giving up its heat to the blast air. There were three stoves for each furnace. Two were being heated while the other was giving up its heat.

The gas used in the stoves was the blast furnace gas that left the top of the furnace. This gas was first cleaned in a dust catcher that removed the larger particles of dust. A high-energy gas scrubber and an electrostatic precipitator removed the remaining 98 to 99 percent of the dust. The stoves used about 25 to 30 percent of the blast furnace top gas and the balance was conveyed to the boiler house where it was burned to produce steam for general use in the steel plant.

3.2.2.4 Hot Metal Desulfurization Facility

This operation, located at the northern end of the open hearth, had full torpedo cars positioned under the facility. Lances were then lowered into the cars to inject reagents into the molten iron to reduce the sulfur content. The fumes generated were captured by an air permitted baghouse. Dust from the baghouse was disposed of offsite by a contractor. This facility was operated and maintained by a contractor from 1986 to 1991.

3.2.2.5 Steel-Making Operations

3.2.2.5.1 Open Hearth Furnaces

The primary method of steel-making at Fairless Works was by open hearth furnaces. Steel-making is the process that refines the iron produced in the blast furnace by blending it with scrap, oxidizing constituents, particularly carbon to specific low levels, then adding various elements to required amounts as determined by the grade of steel to be produced. Steel is defined as a mixture of the elements iron and carbon with an upper limit of carbon content at two (2.00) percent for a classification as steel, and a cast iron classification for carbon content above two (2.00) percent.

Prior to shutdown in 1991, Fairless Works operated nine open hearth furnaces with each vessel capable of producing 395 tons per heat, a maximum capacity of 10,665 tons of steel per day. Fairless Works open hearths produced only carbon-grade steel.

The basic raw materials used for steel-making were hot metal (iron), steel scrap, limestone, burned lime, dolomite, fluorspar, iron ores, iron-bearing materials (such as pellets), and various additional alloying agents that were added as needed to make various carbon steel grades.

During the first part of the charge, limestone, ore, and scrap were charged to the open hearth. Fuel was burned until the scrap charge was melted; then the hot metal was added. During this stage of steel-making, impurities were burned off and the process vaporized or entrained a portion of the molten steel into the off-gases. After recirculating through the open hearth checkers to maintain furnace temperatures, these off-gases were treated by primary and secondary precipitators. Other impurities combined with the slag which floated on the surface of the batch which was separately withdrawn.

The main body of an open hearth furnace is the hearth, constructed of refractory brick supported by the I-beams. Steel-making ingredients of iron, scrap, limestone, and other materials are charged into the front of the furnace through movable doors. Heat is supplied by liquid or gaseous fuel (oxygen) that is ignited by hot air. Continuous hot air flow is maintained by use of a system of regenerative refractory chambers that are located on either side of the furnace.

As hot air flows horizontally across the hearth, it serves the dual purpose of fuel ignition and heating of the opposite regenerative chamber. The hot air flow is periodically reversed to maintain an even hot air flow. In the standard furnace, the operator will heat the steel to required specifications for 6 to 8 hours on average before tapping. Many furnaces, including those at Fairless Works, use oxygen lances to create a more intense heat to reduce the charge-to-tap time to less than 8 hours.

Steel is tapped on the pit side into 400-ton ladles. Prior to tapping, excess slag is flushed out of the center door and dropped through the charging floor onto the pit floor for removal by ground equipment. The remaining slag is tapped with the steel and is run off the top of the steel ladle.

Four (525-ton capacity) overhead pit cranes serviced the nine open hearth furnaces in lifting the 395-ton heats and teeming through bottom nozzles in each ladle into strings of ingot molds on railroad cars along the pouring platform. The finished molten steel tapped from the open hearth furnace was poured into ingot molds. After the steel solidified, the molds were stripped from the ingots at the stripper building. These ingots were charged into soaking pits, or occasionally stocked in the yard for later rolling into slabs, and the molds returned to the mold preparation building.

3.2.2.5.2 Electric Arc Furnace and Continuous Caster

The Fairless Works electric arc furnace (EAF) produced high-quality low carbon steels in one of two 200-ton furnaces. Each furnace was 24 feet in diameter and capable of producing 200 tons in approximately 3 hours. At Fairless Works, the electric arc furnace went into operation in 1972 and was shut down in May 1980. During that time period, the electric arc furnace operated only sporadically due to market conditions.

The electric arc furnace cycle in the steel-making process consists of meltdown, the molten metal period, the boil, the refining period, and the pour. The required heat is generated by an electric arc passing from the electrodes to the charge in the furnace. The refining process is similar to that of the open hearth, but with more precise control and the use of oxygen in the electric furnace. Electric furnaces use scrap steel as a raw material; lime is also added as a fluxing agent.

At Fairless Works, the electric furnace was water cooled by noncontact cooling methods. The gas cleaning used a water mist to clean the exhaust gases. The resulting slurry was pumped to Borrow Pit No. 3 (BP-3). The particulate emissions are also called electric arc furnace dust which was listed as a hazardous waste (K061) in November 1980. The Fairless Works EAF did not operate after the listing of EAF dust as a hazardous waste.

The continuous caster was also water cooled. The effluent from the caster contained water, grease, and iron scale. This effluent was discharged to a scale pit where the oil and scale were separated. The water then flowed to the electric furnace lagoon for additional scale removal prior to discharge to the Terminal Treatment Plant (TTP).

3.2.2.6 Hot Rolling

Hot rolling is the method whereby an ingot is transformed into a semi-finished or finished product. An ingot is the term given to the casting formed as liquid steel, a product from the open hearth steel-making process, solidifies within molds. Following a "stripping" process in which the molds are stripped from the ingot and in preparation for the hot rolling process, the ingots are placed in gas-fired "soaking" furnaces where the ingots obtain a uniform temperature throughout. The ingot is nominally 48" x 36" x 72" high as it is delivered to hot rolling for reduction and processing.

3.2.2.6.1 Primary Mill (Slab Mill)

Ingots are reduced into semifinished shapes on the 45" (maximum width) universal slabbing mill. Direct from the soaking pit furnaces, the ingot is passed back and forth between two large rollers gradually compressing its thickness while increasing its length until the desired dimensions are reached. Vertical rollers are used to keep the edges true and manipulators are utilized to turn the ingot so that it is worked on both sides. The 45" mill converts ingots into two basic shapes; flat slabs which are approximately 9" thick and 24" to 72" wide, and blooms, which are square or slightly oblong in shape ranging in size from 6" x 6" to 9" x 9".

3.2.2.6.2 Hot Strip Mill

The continuous hot strip mill processes the 9" slabs delivered directly from the 45" slab mill. If the hot strip mill continuous operations are disrupted, slab reheating furnaces are utilized to re-heat the slabs to acceptable rolling temperatures. Recent operations required furnaces to be utilized less than 5 percent of the time. The slabs are then sent through a scale breaker and high pressure water sprays that dislodge the loosened scale. The slabs continue to a "roughing" operation where the slab is reduced through a series of four roughing mills to a nominal thickness of 1¼". This operation uses a set of vertical rolls that control the width so that the product emerging from the roughing mills approximates the width of the finished product. The slab, now referred to as a transfer bar, continues toward the finishing mill area where the final size reductions are made. A second scale breaker and high pressure water spray precede the finishing mill. The bar then proceeds to a group of six finishing mill stands placed about 20 feet apart where it is reduced to its final product thickness. Final thickness can be less than 1/8". The finishing mill can turn a 1¼" bar into a thin strip a quarter of a mile in length in 3 minutes or less. Following the last finishing stand, the strip, traveling at speeds up to 2,300 feet per minute, proceeds across "run-out" tables where laminar flow water cooling is applied to the top and bottom surfaces in order to achieve the desired temperature prior to coiling. The strip is then delivered to the final process where any one of three coilers will coil the strip to produce a coil having a maximum outside diameter of 72", a maximum width of 80", and weighing, nominally, 50,000 pounds. The hot strip mill coils may be sold as product or delivered internally for further reduction in the cold rolling mills prior to galvanizing or tin coating. The 45" mill and hot strip mill operations were discontinued in 1991.

3.2.2.6.3 Blooming Mill

Ingots that had previously undertaken a preliminary reduction at the 45" mill could be transferred to a 40" blooming mill in which, through a series of reversing passes, the ingot is reduced to a bloom (9" x 9") for further processing. The 40" blooming mill operation was discontinued in 1989.

3.2.2.6.4 Billet Mill

The 30" billet mill consisting of three vertical and three horizontal reduction stands and the 21" billet mill, with its four alternate vertical and horizontal stands, further reduce the bloom to a 4" x 4" x 60' long billet for further processing. The billet mill operation was discontinued in 1989.

3.2.2.6.5 Bar Mill

Billets are delivered to the 10" bar mill where they are reheated and then processed through a series of 18 individually driven mill stands; 10 with horizontal and 8 with vertical rolls to produce bar products including angles, rounds, and reinforcing bars. Wastewater and scale was collected in scale pits. The bar mill operation was discontinued in 1984.

3.2.2.6.6 Rod Mill

Billets are also delivered to the rod mill. Here they are reheated and processed through a 4-stand mill consisting of three functional sections: a 5-stand roughing mill, an 8-stand intermediate mill (at which the billet, when exiting has been reduced to a 5/8" rod) and a no twist, 10-stand, finishing mill (at which the rod when exiting has been reduced to 3/8" diameter or less). The rod is then coiled, banded, and prepared for shipment. Wastewater and scale were collected in the rod mill lagoon. The rod mill operation was discontinued in 1983.

3.2.2.6.7 Wire Mill

Wire drawing operations began at Fairless Works in the mid-1960s. Semi-finished rod coils were delivered and then drawn into wire on one of nine wire drawing machines. The wire could then be formed into welded fabric. These machines evenly spaced wires horizontally and vertically and welded them at their intersection points.

In 1972, a mini-wire mill was installed at Fairless Works. Hot rolled coils from the rod mill were delivered in diameters from 7/32" to 1/2". In order to remove the scale, workers placed the rod in an acid bath on a traveling gantry crane and then hot water. Lime, borax, or phosphate coatings were applied in one of four tanks, depending on customer requirements. The rod was then baked to dry it and remove the brittleness.

After being cleaned and coated, the rod coils were transferred to the wire drawing area. The diameter of the rod was reduced to the finished diameter by drawing it through both water and air cooled dies at speeds up to 3,000 feet per minute. Wire drawing compounds and lubricants were used to reduce friction and wear.

The Fairless wire mill ceased operating in 1983.

3.2.2.7 Pipe Mill

Welded tubular products are made from hot-rolled skelp (a coiled band 6 to 18 inches in width) with square or slightly beveled edges, the width and thickness of the skelp being selected to suit the various sizes to be made. The coiled skelp is uncoiled, heated, and then fed through forming and welding rollers where the edges are pressed together at high temperatures to form a weld.

At Fairless Works, the reheating furnaces were continuous furnaces in which the charged material moved through the furnace and was heated to rolling temperature as it progressed toward the exit.

3.2.2.8 Sheet and Tin Operations

Hot bands from hot strip mills at other plants are presently delivered via railroad cars to Fairless Works. They are processed through various operations in the Sheet and Tin Division into a high-quality finished sheet. The strip is cleaned, cold reduced, annealed, temper rolled, and/or coated into finished coils for the automotive, durable goods, steel-processing, fabricating, and canning industries.

3.2.2.8.1 Pickling

Coils of hot rolled steel are cleaned or pickled in a bath of hydrochloric acid to remove the surface oxide (scale) that is formed in the hot rolling process. This cleaning is performed on either the 80" or the 56" continuous pickle line, depending on the width and thickness of the coils.

Spent pickle liquor from this process is piped to the Finishing Mill Treatment Plant (FMTP) for storage until used onsite or shipped offsite to water treatment plants as a treatment agent.

3.2.2.8.2 Cold Reduction

Depending on the customer's required width and thickness, pickled coils are reduced in thickness on either the 4-strand or the 5-strand cold reduction mills. In addition to reducing the thickness anywhere from 55 to 90 percent in a matter of minutes, the cold mills impart a smoother surface finish and metallurgical properties to the sheet.

During the cold rolling operation, heat is generated that raises the temperature of both the strip and the rolls. In order to dissipate the heat and control the shape of the sheet, cold rolling solution of lubricant and water emulsions from recirculating systems is applied through spray headers in the Four-High Stands (2 backup and 2 work rolls).

In addition to these rolling lubricants, petroleum oils are used for equipment lubrication and hydraulic operations.

The spent effluents from these processes are piped to the FMTP where separation and reclamation of the oils for boiler fuel is accomplished.

3.2.2.8.3 Cleaning

The cold rolling lubricant from the cold reduction process can be removed, prior to annealing, by running the product through the continuous electrolytic cleaning line.

The strip passes through recirculated alkaline detergent solution tanks that contain electrodes to assist in the cleaning operation. The solution not only acts as a cleaning agent but as conductor for the electrodes in the electrolytic cleaning process. After being rinsed the strip is recoiled for further processing.

The spent cleaning solution and rinse waters are piped to the FMTP, and are neutralized prior to discharge to the Terminal Treatment Plant (TTP).

3.2.2.8.4 Annealing

The cold rolling process hardens the sheet steel so that it usually must be heat treated or annealed in order to restore its ductility and give it the ability to be bent, drawn, and shaped without breaking.

Annealing can be accomplished in either a batch or a continuous operation. Tin and light gauge sheet product moves into continuous annealing; other sheet product goes into batch annealing, and galvanized product is annealed in-line.

In the batch or box operation, coils are stacked on a special base. Cylindrical covers that help control the annealing atmosphere (nitrogen and hydrogen) are placed over the stacks, and huge, box-like covers are placed over the bases. The coils are then subjected to carefully controlled heating and cooling cycles. These coils are then ready for temper rolling at the sheet or tin temper mill.

Continuous annealing is an in-line process in which strips are welded end to end forming a mile-long ribbon of steel that travels through caustic electrolytic cleaning, scrubber and rinse, and controlled atmosphere vertical heating and cooling sections before being recoiled. When this is complete, the coils can be temper rolled.

The spent cleaning solution and hot rinse waters are piped to the FMTP where they are neutralized prior to being discharged as effluent to the TTP.

3.2.2.8.5 Temper Rolling

Processing steel through the tin temper or sheet temper mills gives steel desired physical characteristics by improving its flatness, shape, hardness, and formability, and providing the proper shape and surface finish for each customer.

Product from the tin temper mill moves on to either the electrolytic coating process or the re-coiling process, depending on customer requirements. Product from the sheet temper mill moves directly to the warehouse or can be tension-leveled on the recoil line to meet critical flatness requirements prior to warehousing.

Spent lubricating oils from both temper mills and spent coating oil from the sheet temper mill are piped to the FMTP for separation and reclamation as a fuel.

3.2.2.8.6 Electrolytic Tin Line (ETL)

On the continuous electrolytic tinning line, the strip is subjected to the "Ferrostan" process of tin coating. Material that is welded coil to coil for continuous operation passes through the cleaner and pickler, and into the plating section. There, electric current runs into the solution, depositing a thin coating of tin from the positively charged tin anodes evenly and uniformly onto the negatively charged steel. The strip is then post treated in the melt coat and chem-treat sections prior to passing through the electrostatic oiler and being recoiled.

3.2.2.8.7 Tin-Free Steel Line (TFS)

A second continuous coating line, installed in 1969, applies a chrome coating. This is called the tin-free steel process. Finished coils that are electrostatically oiled in accordance with customer requirements are packaged and prepared for shipment from the tin warehouse.

3.2.2.8.8 Hot Dip Galvanize Line

At the 64" galvanize line, installed in 1968, coils are unwound in a continuous operation, welded end to end, cleaned, heat treated, and coated with a uniform protective layer of zinc. The steel is then cooled, chemically treated, and tension leveled in-line to ensure flatness.

Spent caustic, acidic, and rinse solutions from these three steel-coating operations are piped to the Finishing Mill Treatment Plant, where they are neutralized and treated for contaminant removal into sludges. The sludges are dewatered and transferred to permitted offsite landfills. In addition to these solutions, a small amount of spent lubricating oil from the hydraulic and lubricating systems is piped to the FMTP where it is separated and reclaimed as fuel for onsite use.

3.2.2.9 Support Facilities

3.2.2.9.1 Powerhouse

The powerhouse produced blast air for the blast furnaces in addition to steam and electricity for the plant. The powerhouse controls/dispatches loads for the plant steam, electricity, gaseous fuel, fuel oil, service water, and compressed air systems.

3.2.2.9.2 Central Maintenance

Central maintenance serves as maintenance and shop facilities for the plant. Past activities included a forge shop. Current activities include the electric, machine, carpenter, and fabrication shops, and parts storage.

3.2.2.9.3 Diesel Repair/Mobile Shop

This shop serves as a mobile equipment repair facility. Repairs to locomotives and plant vehicles are undertaken here. A locomotive/truck diesel fueling station lies to the west of this shop.

3.2.2.9.4 Fairless Sanitary Plant

This plant receives sanitary wastes from plant facilities. These wastes enter the comminutor then flow to the pump station. Sanitary wastewaters are pumped to the clarigester, which functions as a primary clarifier and anaerobic digester. Solids settle in the digester where volume is reduced by anaerobic digestion. The remaining solids flowed to drying beds with the leachate returning to the pump station to be sent back through the system again. Clarified sanitary wastewaters flow by gravity to the trickling filters where BOD is reduced by contact with the filter media. Sanitary wastewaters leave the trickling filters to a second clarifier in which biological solids settle. Solids from the secondary clarifier are recycled via a telescopic valve to the pumping station and back through the system for re-seeding. Clarified sanitary wastewaters flow to the chlorine contact tank where they are disinfected and released through an NPDES monitored outfall to the Delaware River.

Sewage sludge was pumped to the greenhouse for drying. A portion was retained and used throughout the plant as fertilizer prior to 1987. Beginning in 1988, sewage sludge was pumped out and disposed offsite.

3.2.2.9.5 USX Realty Sewage Plant

This plant, also referred to as the industrial sewage treatment plant (STP) or package STP, treats sewage from the USX Industrial Park. It is presently owned and operated by USX Realty. The Realty STP is a package DAVCO unit placed in service 20 years ago. The unit provides secondary treatment and has a flow rate of approximately 30,000 to 35,000 gallons per day (gpd). The STP is permitted to discharge 60,000 gpd.

3.2.2.9.6 Potable Water Plant

This facility produces drinking water for the plant and industrial park. It filters water from the Delaware River through conventional sand filters. Filter backwash is conveyed to the Terminal Treatment Plant.

3.2.2.9.7 Scrap Preparation Area

The scrap preparation area occupies an area of approximately 10 acres and is located southwest of the Main Gate and northeast of the former American Can Company facility. It was used for the collection and processing of metal scrap.

3.2.3 Solid and Hazardous Waste Generating, Handling, Treatment, Storage, and Disposal

3.2.3.1 Generation of Solid and Hazardous Wastes

A variety of waste streams were generated by operations at Fairless Works. Both a description of these materials and the processes involved in the generation of the wastes, by operation, are provided below. A summary of hazardous and nonhazardous solid and aqueous wastes is presented in Table 4. This table shows only wastes that were disposed, not wastes that were recycled or re-used. Chemical analysis and volumes for slag, slag water leachates, and hazardous and nonhazardous sludge and water leachates for different processes are presented in Appendix A.

3.2.3.1.1 Coke Plant

The Fairless Works Coke Plant operated from 1953 until 1984. Wastes generated included:

- Tar Decanter Sludge
- Ammonia Still Lime Sludge
- Coke Breeze

Tar decanter sludge (TDS) is a black sludge produced during the separation of tar from flushing liquors used to condense tars and other condensable compounds produced during the high-temperature distillation of coal. Ammonia still lime sludge is a byproduct of the treatment of ammonia-containing liquor, also condensed from vapors driven off during coke production. Tar decanter sludge and ammonia still lime sludge are listed as hazardous wastes (K087 and K060, respectively).

TDS was deposited in borrow pits BP-8A, BP-8B, BP-13, and BP-20. Chemical analysis of surface water at BP-8A identified the following constituents (Chester Engineers, 1981): oil and grease, organic carbon, chlorides, ammonia, phenols, cyanide, iron, magnesium, and zinc. Chemical analysis of bottom sediments in BP-8A and BP-8B detected oil and grease, barium and cadmium (Golder, 1988). Ammonia still lime sludge was deposited in BP-14 (north and south). Coke fines (breeze) were placed in BP-8A.

3.2.3.1.2 Sinter Plant

The Fairless Works sinter plant operated from 1956 until 1990. Wastes generated included:

- Sinter plant sludge

Sinter plant sludge is a red-brown sludge developed from fine dust removed by rotocyclones for the sintering lines. Dry solids were recycled to the sinter plant. Wetted solids (sludge) from the rotocyclones were processed through a classifier. Most of the sludge was pumped to BP-3 with blast furnace sludge for recycling prior to the 1985 consent decree with the Pennsylvania Department of Environmental Resources (PADER). Sinter plant sludge from BP-3 was removed with dragline and recycled in the sinter plant. Sinter plant sludge was pumped to the Terminal Treatment Plant after disposal in BP-3 ceased in 1985.

3.2.3.1.3 Blast Furnaces

The Fairless Works blast furnaces operated from 1952 until 1991. Wastes generated included:

- Slag
- Flue Dust
- Filter Cake
- Blast Furnace Blowdown
- Ore Screenings
- Cast House Debris
- Coke Fines

Blast furnace slag, a co-product of iron-making, is a fused gray agglomerate consisting of impurities remaining after the refining of iron ore into iron. Slag consists of calcium, silica, alumina, and other oxides. The typical composition of blast furnace slag is provided in Table 5. Blast furnace slag is produced in three physical forms depending on the method of cooling. These physical forms include air cooled, granulated, and expanded. Blast furnace slag has been successfully used in a variety of commercial applications and it is listed by the U.S. Bureau of Mines as an economic mineral product. The Bureau of Mines (Solomon, 1993) reported that, in 1991, production of blast furnace slag totaled 14,653,000 tons with a value of $109,877,000. Principal uses of blast furnace slag include:

Air Cooled Slag (crushed and screened)

Railroad ballast
Aggregate for concrete and asphalt
Sewage treatment plant trickle filter media
Roofing granules
Porous backfill and underdrains
Road construction gravel

Granulated Slag

Portland cement
Agricultural soil conditioner
Concrete blocks
Special subgrades and subbases
Ceramic ware and glass sands

Expanded Slag

Concrete masonry units
Structural concrete
Fireproofing
Acoustical tile
Floor tiles
Floor joists and slabs

A variety of leaching tests have been performed on samples of blast furnace slag from Fairless Works. The results of these leaching tests are provided in Table 6. The test methods included the extraction procedure toxicity test (EP Tox), the Toxicity Characteristic Leaching Procedure (TCLP), and an ASTM water leaching test. These tests indicated that metals do not leach from the slag at concentrations exceeding regulatory levels. Additional analyses are presented in Appendix G.

Blast furnace slag was processed and stored for reuse by an outside contractor. The contractor operated a pelletizer that processed molten slag into small pellets which were sold as a construction material. Approximately 50 percent of the slag was managed and reused by this method. The remaining slag was air and water cooled. The contractor recovered metallics for recycling to the blast furnaces and open hearth. The remaining slag was then size-graded and sold as construction material and used as engineered fill material. A small amount of slag was placed in Permitted Slag Disposal Area B.

Flue dust from the blast furnaces consists of fine, dark gray dust separated from flue gases by a dust catcher built onto each furnace. Flue dust was placed in railcars and transported to an area in the southwest corner of BP-3. The dry dust was prepared for recycling by mixing it with wet flue dust and blast furnace filter cake. Blast furnace filter cake is a black cake produced by the removal of solids from the venturi scrubber. Historically, blast furnace sludge was pumped to BP-3 for recycling to the sinter plant. After the sinter plant ceased operations, this material was sent offsite to other sinter plants.

Ore screenings are fine particles of iron ore that remained behind after screening operations in the ore yard. Ore screenings were collected by a contract hauler and recycled by sintering.

Debris from the cast house includes solid wastes generated by casting operations, demolition, and construction, particularly blast furnace rebuilds (refractory brick, slag, metallics, sand, etc.). Cast house debris was stockpiled onsite by plant personnel. Recyclable materials (slag and metallics) were processed for reuse. Nonusable materials were landfilled offsite.

Coke breeze (fines) are a black dust produced by the screening of coke. The fines were recycled through the sinter plant.

3.2.3.1.4 Open Hearth Furnaces

The Fairless Works open hearth furnaces operated from 1952 until 1991. Wastes generated included:

- Slag
- Primary Flue Dust
- Secondary Flue Dust
- Debris

Open hearth slag consists of fused gray agglomerate left behind after the steel-making process is complete. Primary and secondary flue dusts are fine red metallic dusts separated from flue gases by electrostatic precipitators. Open hearth debris consists of wastes generated by demolition, construction, and general operation of the open hearth furnaces, particularly furnace and ladle relines (refractory brick, slag, metallic, etc.).

Open hearth slag was processed for recycling or reuse by first removing the iron-bearing metallics, which were recycled through the blast furnaces and open hearth for iron recovery. The remaining slag was size-graded; a portion of this material was recycled to the sinter plant, blast furnaces, and open hearth for use as a flux agent. An additional amount was reused and/or sold as construction material. The U.S. Bureau of Mines reported that, in 1991, production of steel-making slag totaled 7,761,000 tons with a value of $23,732,000 (Solomon, 1993). The remainder, which consisted of pieces too large for processing, was placed in onsite borrow pits and in Permitted Slag Disposal Area B during the late 1980s.

Historically, primary and secondary flue dusts were slurried and pumped to the north end of BP-3. Beginning in 1987, a sludge dewatering plant became operational and the sludge was disposed offsite at a permitted landfill. The majority of the dust was removed dry from the secondary precipitator hoppers and sold commercially offsite by subcontractors.

Open hearth debris consisting primarily of bricks was utilized onsite as fill material.

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3.2.3.1.5 Electric Arc Furnace and Continuous Caster

The Fairless Works electric arc furnace operated intermittently from 1972 until 1980. Wastes generated included:

- Slag
- Emissions control sludges
- Continuous caster scale

Electric arc furnace slag is a fused gray agglomerate similar to other slags generated on the site. These slags were also used for a variety of commercial purposes including construction and road bed applications.

Electric arc furnace sludge was produced by scrubbing flue gases until May 1980. The flue dusts and sludges were placed in a segregated section in the southeast end of BP-3. In November 1980, electric furnace sludge was listed as a hazardous waste (K061). The furnace only operated intermittently during a period of 8 years (from 1972 to 1980), prior to the listing of EAF dust as a hazardous waste.

Continuous caster scale was recycled in a sinter plant.

3.2.3.1.6 Hot Rolling Mill

The Fairless Works Rolling Mill operated from 1952 until 1991. Wastes generated included:

- Mill Scale
- Waste Oil
- Debris

Rolling mill scale is a metallic material (iron oxide particles) that is formed during the hot forming operations. It is removed mechanically from the surface of the products by roll force and high pressure water sprays. The water carries it into concrete scale pits for settling and removal for recycling in the iron-making process.

Used oils consisting of equipment lubricants, hydraulic fluids and a sporadically used hot rolling lubricant were collected from the scale pits by skimmers or vacuum trucks and transported to a reclamation facility onsite. The oil was reclaimed for use as fuel.

Debris generated during normal mill operations and reheat furnace cleanouts was handled two ways: the metallic portion was processed onsite by a contractor for recycling and the remainder was collected and transported to a landfill.

3.2.3.1.7 Sheet and Tin Mill

The Fairless Works sheet and tin mill began operating in 1952 and continues to operate at this time. Wastes generated include:

- Finishing Mill Treatment Plant (FMTP) Sludge
- FMTP Chromic Sludge
- Galvanizing Dross
- Tin Skimmings
- Tin Plating Sludge
- Spent Pickle Liquor
- Spent Chromic Solution
- Waste Oils

FMTP sludge is a red precipitate produced by the treatment of caustic, acidic, and oily wastes discharged from the sheet and tin mill. FMTP sludge was pumped into BP-1 until 1972 and into Borrow Pit NT-3 until 1988 when the sludge dewatering plant became operational.

FMTP chromic sludge is produced by the treatment of chromic acid rinse solutions from the electrolytic tinning, tin-free steel, and galvanizing operations. This sludge has elevated levels of chromium. The spent chromic rinse is a corrosive liquid classified as a characteristic hazardous waste (D007).

Galvanizing dross is a silver gray metallic fused agglomerate consisting of solids skimmed from the zinc pot on the galvanizing line. Galvanizing dross is cast into 2,200-pound pigs and loaded into trucks for transport to various metals reclamation companies. This material is recovered and sent for reclamation offsite.

Tin skimmings form a gray solidified mass consisting of impurities skimmed from the surface of the tin pot on the electrolytic tinning line. Tin skimmings are cast into pigs and transported offsite to a metals reclaimer. This material is consumed by offsite reclamation.

Tin plating sludge is a gray granular precipitate that accumulates on the bottom of the tin plating solution tank. Tin plating sludge is removed from the bottom of the plating solution tank into a container for offsite metals reclamation. This material is consumed by offsite reclamation.

Hydrochloric acid is used to remove scale and other unwanted materials from the steel products, producing spent pickle liquor, a corrosive liquid that is classified as a hazardous waste (K062). The wastewaters from rinses following pickling processes consist of spent solutions, rinse waters, and water used in fume scrubbers. The fume scrubbers are used as an industrial hygiene measure due to the volatility and character of the fumes from hydrochloric acid. Spent pickle liquor (SPL) is piped to the FMTP for storage. This liquor was periodically lime stabilized in the past before disposal in Borrow Pit NT-3. Lime stabilized SPL is not a hazardous waste. This material is now reused offsite.

Spent chromic solution consists of spent chromic acid dips and rinse waters from the electrolytic tinning, tin-free steel, and galvanizing lines. Spent chromic solution was piped to the chrome destruct system at the FMTP where hydrochloric SPL was added to reduce hexavalent chrome into trivalent chrome. This effluent was routed into the FMTP system where the trivalent chrome was removed via clarification. The FMTP effluent was then discharged through an NPDES-permitted outfall. Spent chromic wastewaters are generated from the tin-free steel line, the galvanizing line, and the electrolytic tin line. These wastewaters go to the chrome wastewater treatment system (part of FMTP) where the water goes through equalization and is collected in 2 tanks of 16,500 gallon capacities. Sulfur dioxide (SO_2) is then added prior to mixing, followed by chrome reduction in a 16,500-gallon reaction vessel. The wastewater is then piped to an acid sump, where caustics are added. Finally, the water is mixed and sent to a clarifier where the filtrate is returned to the system and the sludge is sent to the dewatering facility. Effluent from this system goes to Outfall 403.

Oils (oil/water mixtures) are left behind after lubricating and coating steel during forming processes. Used oil collected as part of the FMTP process is processed into fuel at the onsite reclamation facility. This oil is reclaimed and reused onsite.

3.2.3.1.8 Pipe Mill

The Fairless Works pipe mill began operating in 1952 and portions of this mill are currently operated under a lease to LaClede Steel. Wastes generated include:

- Galvanizing Dross
- Spent Pickle Liquor
- Spent Chromic Solution
- Acid Rinse

The pipe mill was operated by U.S. Steel until 1991. Beginning in May 1992, LaClede Steel restarted portions of the pipe mill.

Galvanizing dross was also generated by the pipe mill galvanizing line. Spent pickle liquor generated by this facility consisted of spent sulfuric acid. Chromic rinse spent solutions were also produced by the pipe mill galvanizing operation.

Galvanizing dross materials were collected and transported offsite by a reclamation company for recovery of zinc. This material was reclaimed offsite.

Spent sulfuric pickle liquor from the pipe mill was stored in a fiberglass tank adjacent to the facility. The liquid was periodically removed for reuse or disposal. Spent chromic solution, also stored in a fiberglass tank adjacent to the pipe mill, was periodically removed for treatment or disposal.

3.2.3.1.9 Wire Mill

The Fairless Works wire mill operated from 1965 until 1983. Wastes generated after installation of the mini wire mill in 1972 included:

- Spent Pickle Liquor
- Acid Rinse Water
- Borax

Spent pickle liquor and acid rinse waters were derived from cleaning the rods or wire. Borax was used to coat rods prior to drawing to protect them from oxidation and to act as a carrier for drawing lubricants.

Spent pickle liquor was stored in a tank adjacent to the facility. The liquid was periodically removed for reuse or disposal. In the past, acid rinse water and borax wastes were placed in BP-40 adjacent to the wire mill in quantities that are unknown, but believed to be small. Spent pickle liquor was collected for reuse as a water treatment chemical, and after 1979, the rinses and borax were handled at the FMTP.

3.2.3.1.10 Cold Mill

The effluents from the cold mill consisted of emulsified oils and suspended solids. A detergent was often used at the final stand to remove any oil from the sheet. Oils used in the cold mill were of mineral, animal, or vegetable origin, and were either soluble or insoluble. The oils were found in different degrees of being free or emulsified and saponified or unsaponified. Depending upon the nature of the product being rolled, lubrication and cooling were applied either on a once-through basis or recycled. These effluents were treated at the FMTP.

3.2.3.1.11 Support Facilities

Terminal Treatment Plant (TTP) Sediment
Sanitary Treatment Plant Sludge
Power House Sludge
Service Water Sediment
Potable Water Treatment Plant Sludge
Finishing Mill Treatment Plant Sludges

TTP sediment is a black sediment removed from settling basins and lagoons at the Terminal Treatment Plant. The TTP received wastewater from several areas of the plant including the hot strip mill, pipe mill, and the power house water treatment plant. Treatment consisted of aeration, API separators, oil skimming, and precipitation of solids. TTP sediment was placed in BP-35, BP-35A, BP-35B, and BP-35C until 1988.

Sanitary sludge is a brown sludge produced by solids settling and clarification of sanitary wastewater at the sewage treatment plant. No industrial wastewaters entered this system. In the past, sanitary sludge was removed in dried form from the drying beds for offsite disposal at the G.R.O.W.S. landfill. A small portion was retained for onsite use as a fertilizer. More recently, the sanitary sludge has been removed as a slurry for offsite treatment and disposal.

Power House sludge is a brown precipitate produced by the clarification, filtration, and softening of water to be used in the boilers. Power House sludge is pumped to the TTP for solids removal. The solids become part of the TTP sludge and the effluent is discharged through a NPDES-permitted outfall.

Service water sediment consists of river silt and was produced by the settling of water drawn from the Delaware River for use as the plant's nonpotable water supply. Service water sediment was periodically dredged from the sedimentation basins and placed onsite in BP-35C and north and south of the sedimentation basins.

Potable water plant sludge is a brown precipitate produced by the solids removal processes at the potable water treatment plant. This sludge is pumped from the potable water treatment plant to the TTP where the solids become part of the TTP sludge.

FMTP sludge is produced by the treatment of wastes from the sheet and tin mill. In the past, this sludge was discharged to BP-1 and BP-3. It is now dewatered and disposed offsite.

3.2.3.1.12 General Plant Wastes

- Spent Solvents
- General Refuse
- Used Tires
- Used Railroad Ties
- Used Oil
- Asbestos Containing Materials
- Demolition Debris
- Refractory Debris

Most of these wastes were produced from general plant operations at numerous locations within the Fairless Works.

Since 1985, solvents used onsite are picked up by an outside contractor for offsite recycling. Previously, solvents were fuel-based and were typically burned onsite.

General refuse, consisting mostly of paper, wood debris, and minor amounts of scrap metal, was placed in the refuse disposal area (see Section 3.2.3.2.8) onsite. Starting in 1987, it was removed by a contract hauler for disposal in the G.R.O.W.S. landfill. Used tires are collected and transported offsite by an outside contractor for reuse or disposal. Used railroad ties were stockpiled onsite with suitable ties reused for track repair. The remaining ties were disposed offsite.

Used oil from miscellaneous plant sources is collected and transported to the onsite reclamation plant (part of the FMTP) where it is processed into fuel.

Asbestos containing materials, used for various insulation purposes throughout the plant, is bagged in accordance with regulations and is either stored in a closed metal box for transport to an approved landfill or is disposed of by outside contractors as part of their project specifications. Asbestos containing materials in facilities to be demolished have been or are being removed for disposal at an offsite facility.

Demolition debris was generated by plant maintenance activities and consisted of concrete, brick, wood, and similar materials. These materials were disposed in the refuse disposal area (see Section 3.2.3.2.8) onsite in the past. Currently, demolition debris is handled in accordance with Pennsylvania residual waste regulations.

Refractory debris consists primarily of refractory bricks from relining of furnaces, stoves, ovens, and other high-temperature vessels. This material was used as fill in various locations onsite.

3.2.3.2 Waste Handling, Treatment, Storage, and Disposal Facilities

3.2.3.2.1 Blast Furnace Slag Reprocessing Area

This area was located to the west and northwest of the blast furnaces. It was active from 1965 until 1991. It occupied an area of approximately 100 acres of level ground with bare soil and was used for the reprocessing of blast furnace slag into various grades by an outside contractor for sale as construction and road material. The slag from the furnace was processed by air cooling or expansion.

3.2.3.2.2 Blast Furnace Dust/Sludge Recycling Operation

This waste recycling operation was active from 1982 until late 1991. This area is located to the east of the blast furnaces. It occupies approximately 3 acres of level ground with bare soil and was used for the mixing and storage of filter cake from the blast furnace and flue dust from the blast furnace. These materials were then recycled to a sinter plant.

3.2.3.2.3 Finishing Mill Treatment Plant

The Finishing Mill Treatment Plant, or FMTP (formerly referred to as the Oil Interception Plant, or OIP), is located on the south side of the sheet and tin mill. It is a treatment facility for wastes discharged from the sheet and tin mill and pipe mill (LaClede Steel). It also treats small amounts of waste from the bar mill warehouse (Chicago Steel). In the past, it also treated wastes from other facilities that are no longer operating. This plant currently receives acid rinses, insoluble oils (rolling and lubricating), oily water, alkaline rinses and chromic rinse. These wastes are treated by oil skimming, acid neutralization, and metal precipitation. The general layout of the FMTP is shown in Plate 16. Effluent from this facility is discharged to the Terminal Treatment Plant. In the past, sludges were discharged to BP-1 until 1972, and into borrow pit NT-3 until 1988 when the sludge dewatering plant became operational. The FMTP is operated under NPDES Permit No. PA0013463, Outfall 403.

3.2.3.2.4 Finishing Mill Treatment Plant Spent Pickle Liquor Tanks

These two tanks are located at the FMTP immediately south of the sheet and tin mill (see Plate 16). They are secondarily-contained metal tanks with acid-resistant coatings. Each has a capacity of 225,000 gallons. These tanks are operated as 90-day waste accumulation sites and are used to store spent hydrochloric acid from the 80-inch and 56-inch pickle lines.

3.2.3.2.5 Pipe Mill Chromic Rinse Tank

This tank is located near the north end of the pipe mill (now leased by LaClede Steel). It is a doubly-contained, fiberglass aboveground tank with a capacity of 15,000 gallons. It was operated as a 90-day waste accumulation site and was used to store chrome-bearing wastewater from the pipe mill galvanizing process.

3.2.3.2.6 Pipe Mill Zinc Dross Storage Area

This area is located near the northwest corner of the pipe mill (now leased to LaClede Steel). It is inside on the mill floor and is used for the accumulation and storage of zinc dross for offsite recovery by a metal reclaimer.

3.2.3.2.7 Pipe Mill Spent Pickle Liquor Tank

This tank is located near the north end of the pipe mill (now leased to LaClede Steel). It is a fiberglass aboveground, doubly-contained tank of 20,000 gallons capacity. It was operated as a 90-day waste accumulation site and was used to store spent sulfuric acid from the pipe mill.

3.2.3.2.8 Refuse Disposal Area

The refuse disposal area is located east of BP-35 on a site covering approximately 14 acres. Prior to use for disposal, the area consisted of level ground with sparse vegetation. This area was active from 1952 until 1985 and was used for the disposal of general plant refuse or debris. These materials include municipal waste, waste paper, wooden pallets, broken furnace lining materials, refractory brick, waste building materials, ore fines, and rubble. The location of the refuse disposal area is shown on Figure 14.

3.2.3.2.9 Rod Mill Settling Lagoon

The rod mill settling lagoon is a horseshoe-shaped basin located immediately to the south of the rod mill and partially constructed on BP-1. Its location is shown on Figure 14. It is lined with gunite and has a capacity of 7.5 acre-feet. It was used for the treatment of industrial wastewaters from the rod and wire mills. Scale was removed by a clam-shell. Oil was removed by a drum skimmer. Effluent from this facility was discharged to Canal No. 2 under NPDES Permit No. PA0013463, Outfall 102. This lagoon was used from 1969 until 1984.

3.2.3.2.10 Rod Mill Scale Pile

This area is located immediately to the east of the rod mill adjacent to the rod mill settling lagoon and is situated on BP-1. It occupies approximately 0.5 acre of level ground on bare soil and was used to store scale from the rod mill settling lagoon for recycling at a sinter plant. It was used from 1969 until 1984.

3.2.3.2.11 Sewage Plant Drying Beds

These drying beds were classified as waste handling areas and are located immediately to the south of the Terminal Treatment Plant. They are aboveground concrete-lined cells (capacity - approximately 315 cubic yards) with a common, glass-enclosed greenhouse cover. These beds were active from 1952 until 1984 and were used for the drying of sanitary sewage sludge from the sanitary sewage treatment facility.

3.2.3.2.12 Galvinizing Line Zinc Dross Storage Area

This area is located near the northeast corner of the sheet and tin mill. It is inside on the building floor and consists of an enclosed area used for the accumulation and storage of zinc dross for offsite recovery by a metal reclaimer.

3.2.3.2.13 Sinter Plant Material Staging Area

This area was classified as a recycling operation. It was located south of the blast furnaces and east of the sinter plant. The area is approximately 1 acre of level ground on bare soil and was used as a staging area for various solid materials to be recycled to the sinter plant. These materials include scale from various finishing operations and dust/sludge mixtures from the blast furnaces. Activities at this staging area ceased in 1990 when the sinter plant ceased operations.

3.2.3.2.14 Permitted Slag Disposal Areas

Two areas were permitted by PADER as landfills for disposal of slag. Area A, including Borrow Pits 28 and 28A, is located northwest of the pipe mill. This area was not used for slag disposal, although some slag was used to construct the road adjacent to these borrow pits. Area B is located immediately to the north of the pipe mill. The area is an irregular rectangle in shape that occupies approximately 8.5 acres. This area received slag from the open hearth furnaces. This area includes Borrow Pits NT-1 and NT-2.

3.2.3.2.15 Terminal Treatment Plant

The Terminal Treatment Plant (TTP) was constructed to treat industrial wastewaters from the integrated steel-making facility. Wastes received by the plant historically included process wastewater from the coke-making, iron-making, steel-making, sintering, finishing operations, and associated utilities. The flow and character of the wastewaters has varied since the commencement of the manufacturing activities due to changes in process and operations.

Water treatment processes at the TTP consist of aeration, presedimentation, oil skimming, and sedimentation in the basins prior to discharge via an NPDES-permitted outfall. Primary treatment of current wastewaters occurs at the FMTP. Three basins (Basin Nos. 1, 2, and 5) were first constructed at the TTP to handle the wastewater flow. However, due to the growth of the integrated steel-making facility, Basin Nos. 3 and 4 were added to provide for the necessary retention capacity. Presently, only Basin Nos. 3, 5, and the southeast corner of 4 are used for sedimentation because only the finishing mills, pipe mills, and associated utilities are operational.

The total area of each of the active basins is 57,000 square feet (ft^2) for Basin No. 3, 14,940 ft^2 for Basin No. 4, and 125,350 ft^2 for Basin No. 5. The locations of the basins are shown in Figure 14.

Solids were last removed from Basin Nos. 3 and 5, and the southeast portion of 4 in September 1991. The dredging from this cleanout was placed in the remaining portion of Basin No. 4. Prior to this dredging, solids removed from all of the basins were placed into BP-35. Previous accumulation of solids totaled approximately 20,000 tons over a 2-year period. Due to the reduced flows from the plant, approximately 500 to 600 tons are estimated to collect annually in Basin Nos. 3, 5, and the southeast section of 4.

Permitting for the Terminal Treatment Plant was issued by the Commonwealth of Pennsylvania Department of Health Sanitary Water Board Industrial Wastes Permits No. 1818 on November 15, 1956, and No. 1524 on February 15, 1952. These permits allow for construction and operation of the impoundments. These permits were incorporated into the overall facility NPDES Permit No. PA0013463, issued on December 18, 1990.

U.S. Steel continues to operate portions of the TTP to treat the effluents from the FMTP, pipe mill, and power house. Pipe mill effluent, prior to going to the TTP, goes to a scale pit where oil is skimmed off. In addition, U.S. Steel has submitted applications for this operating portions to PADER in accordance with state's residual waste regulations.

3.2.3.2.16 Wire Mill Spent Pickle Liquor Tank

This tank was located on the east side of the wire mill. It was a rubber-lined steel tank with a 25,000-gallon capacity. It was operated as a 90-day waste accumulation site and was used to store spent sulfuric acid from the wire mill. This tank was removed in 1985.

3.2.3.2.17 Electric Furnace Caster Basin

This basin is located next to the Rod Mill Settling Lagoon to the south of the rod mill (Figure 14). This basin received wastewaters from the continuous caster and was used to separate the solids and the oily wastewater. It is a concrete lined basin approximately 200 feet long and 60 feet wide. This basin is now referred to as the VAC-ALL Basin and it receives wastes containing heavy oils and greases from general cleanup activities. The oils and water from the basin are treated at the FMTP. The waste solids are periodically removed for disposal at an offsite landfill.

3.2.3.2.18 Other Waste Facilities

Some waste handling facilities have been converted to other uses after their original use ceased operations. For example, the former electric furnace caster basin, now called the VAC-ALL Basin, is used as a residual waste impoundment and a permit application has been submitted to PADER.

Underground sewer and piping systems are addressed in Section 3.6 of this report. Underground tanks that contained either product or waste materials are also addressed in that section.

A designated PCB storage building is located north of the Central Maintenance building. It is a metal building with a concrete floor. This storage facility is used to store PCB-containing equipment prior to reuse or disposal. Transformers are stored on steel containment pans. It is operated in accordance with requirements of the Toxic Substance Control Act (TSCA).

3.2.3.2.19 Other Areas of Concern

A variety of other areas of concern exist at Fairless Works. These include undocumented releases or disposal activities that have been located by plant personnel, such as waste piles of sludges, scale, and bricks in the scrap preparation area and the slab yard. Other areas where waste materials were deposited on the ground have subsequently been cleaned up by removal and disposal of the wastes. These include the coal yard where sinter plant and blast furnace feedstock blending occurred after the coke plant ceased operations, a pile of blast furnace flue dust (removed in 1987) that was located near the west loop road, and the recycle pile near the sinter plant. Other spills, which are undocumented, have been noted at Fairless Works during previous site investigations. Most represent releases that happened a number of years ago. These include releases of tar in and around the coal chemical portion of the coke works that stopped operating in 1984.

3.2.3.3 Quantities of Solid and Hazardous Wastes

Operations at the Fairless Works have generated both hazardous and nonhazardous wastes. Table 4 provides a summary of waste disposal with reported quantities. Appendix A provides additional information on descriptions of process waste, volumes, and analyses.

3.2.3.3.1 Hazardous Wastes

Iron-making, steel-making, and finishing operations at Fairless Works generated hazardous and nonhazardous wastes. Hazardous wastes were generated at the coke plant, sheet and tin mill, and the pipe mill. Since the shutdown of the coke plant (1984), the two remaining generators of hazardous waste at Fairless Works are the sheet and tin mill and the pipe mill.

3.2.3.3.2 Nonhazardous Solid Wastes

Nonhazardous solid waste at Fairless Works was generated at the open hearth furnaces, blast furnaces, sinter plant, rolling mills and EAF facility. Currently, the TTP, sanitary treatment plant, sheet and tin mill, and power house generate nonhazardous sludge. Other nonhazardous solid wastes generated from Fairless Works operations include: railroad track debris, pipe mill debris, and contractor refuse.

3.2.3.4 Slag Material Used as Engineered Fill

Slag generated from the blast furnace, open hearth, and electric arc furnace was either sold as a construction material or used as engineered fill onsite in borrow pits. Chemical analyses of open hearth slag and electric arc furnace slag identified these primary constituents: CaO, SiO_2, FeO, Al_2O_3, MgO, MnO, P_2O_5, and S. Chemical analyses of blast furnace slag identified these primary constituents: CaO, SiO_2, FeO, Al_2O_3, MgO, MnO, and S. Slag analyses (percentage) are summarized in Table 5.

3.3 PREVIOUS FIRES AND SPILLS

Documented fires and spills that have occurred in the past at Fairless Works are described and listed in Tables 7 and 8, respectively. Plates 19 and 20 show the location of each incident.

3.4 PERMITS

Permits for the Pennsylvania Air Pollution Control Act, Solid Waste Management activities, Pennsylvania Clean Streams Law (NPDES), and other miscellaneous permits that U.S. Steel Fairless Works has requested/received in the past are listed in Table 9.

3.5 PCB TRANSFORMERS

The PCB transformers that have been in use at Fairless Works are listed in Appendix B. The locations are shown on the series of Figures included as Plate 21. Dikes were constructed around all PCB-containing transformers in 1976. Complete inventories of the transformers were performed in 1980, 1987, and 1990. The only transformer known to have released PCB oil is No. 39 located at the Air Separation Plant.

3.6 ABOVEGROUND AND UNDERGROUND PIPING AND STORAGE TANKS

Piping and storage tanks at Fairless Works can be broken down by type or related process. The following is a summary of the piping and storage tanks found onsite with the reference to the detailed drawing prepared by U.S. Steel. These referenced drawings are included in this report as Plates. Appendix C also presents a listing of the storage tanks, both above and below ground, found onsite.

Plate No.	Drawing Description	Fairless Works Reference Drawing
Plate 1	• Service Water Supply System	E-82363
Plate 2	• Sanitary Sewer System Booster Stations	E-87350
Plate 3	• Storm Sewer System - Key	E-87354
Plate 4	• Fuel Oil System	E-89572
Plate 5	• Fuel Oil System - Conversion of Natural Gas to Fuel Oil - 1975 - Key	E1-81597
Plate 6	• Industrial Waste Sewers - Key	E-87355
Plate 7	• Potable Water Supply System - Key	E-87226
Plate 8	• Water Quality Control Facilities	E1-81980
Plate 9	• Natural Gas Supply System - Key	E-84931
Plate 10	• Oxygen Piping Diagram	E-87460
Plate 11	• Steam Piping Diagram	E-87456
Plate 12	• Compressed Air Piping Diagram	E-87457
Plate 13	• Mixed Gas Diagram	E-87458
Plate 14	• Nitrogen Gas Supply System - Key	E-89701
Plate 15	• Hydrogen Gas Supply System - Key	E1-80478
Plate 16	• Oil Interception Plant - Key	E-3-80027
Plate 17	• Tank Location Map	F-80821

3.7 CANALS

The three canals onsite receive permitted NPDES discharges of noncontact cooling water, sanitary effluent, and storm water runoff from the facility. Tidal effects are noted in the canals but differ with locations. The East Canal, below the NPDES monitoring point, is affected by tides but the area upstream of the monitoring point is not affected. The central Canal is tidal to a significant distance upstream from the point of discharge to the river. The West Canal, emptying into the boat slip, only receives storm water runoff. The effects of the tides in the West Canal are unknown. Although observations indicate tidally induced flow in portions of the canals, no data are available to quantify this condition. The locations of the canals are shown on the topographic map as well as Plate 3, Storm Sewer System.

3.7.8 COMPLIANCE BACKGROUND INFORMATION

The following section is a brief summary of Notices of Violation and enforcement actions issued by EPA, PADER, or Bucks County to Fairless Works for the approximate period of 1980 to 1991. The majority of the processes identified in this summary are no longer in operation.

- On 8/28/86, the County of Bucks Department of Health issued a notice of violation concerning first stage oxygen demand problems at Outfalls 002 and 103. Also the notice of violation addressed chromium violations at Outfall 403. USX resolved this matter in correspondence dated 9/25/86.

- On 9/3/86, the Bucks County Department of Health issued a notice of violation alleging exceedances of NPDES limits for Outfalls 002 and 103. USX responded to the Health Department in correspondence dated 9/25/86 explaining the reason for the exceedances and the corrective action to be taken.

- On 12/4/87, EPA issued a notice of violation (III88-001-VA) alleging violations of the visible emission standard section of the Pennsylvania State Implementation Plan (SIP) at facilities No. 2 windbox stack and at the open hearth secondary precipitator exhaust stack. Due to the closure of the sinter plant and subsequently the hot end in 1991, these alleged violations are no longer applicable. A consent decree with PADER and EPA resolved past issues.

- On 1/29/88, PADER issued a notice of violation alleging violations of an open hearth low emission operating procedure, §127.25 of PA Title 25 Rules and Regulations. Additionally, a violation was alleged at the secondary precipitator exhaust stating the visible emissions (VEs) from the secondary stack were greater than 20 percent for more than 3 minutes per hour. Due to the closure of the sinter plant and subsequently the hot end in 1991, these alleged violations are no longer applicable. A consent decree with PADER and EPA resolved past issues.

- On 3/31/88, EPA issued a notice of violation (III-88-017-VA) alleging violations of the Pennsylvania SIP opacity regulations at facilities Nos. 2 and 3 blast furnace cast house roof monitors, the open hearth shop roof monitor and the sinter plant No. 4 Roto-Clone stack. Due to the closure of the sinter plant and subsequently the hot end in 1991, these alleged violations are no longer applicable. A consent decree with PADER and EPA resolved past issues.

- On 6/27/88, the County of Bucks Health Department issued a notice of violation concerning various permit violations (pH, oil and grease, and freeboard lagoon levels). USX responded in correspondence dated 7/8/88, which resolved this matter.

- On 7/7/88, PADER issued a notice of violation alleging visible emissions equal to or greater than 20 percent for more than 3 minutes in one hour from the open hearth roof monitor, blast furnace roof monitor, and No. 4 sinter Roto-Clone stack. The same sources were noted for visible emissions equal to or greater than 60 percent at any one time. Due to the closure of the sinter plant and subsequently the hot end in 1991, these alleged violations are no longer applicable. A consent decree with PADER and EPA resolved past issues.

- On 9/12/88, PADER issued a notice of violation alleging VEs from the open hearth secondary electrostatic precipitator equal to or greater than 20 percent opacity for 31.75 minutes in one hour. Eleven of these minutes were equal to or greater than 60 percent opacity. USX addressed the matter in responsive correspondence dated 10/3/88, indicating a new automatic power system had been effected.

- On 11/21/88, PADER issued a notice of violation alleging VEs equal to or greater than 20 percent opacity for 15½ minutes and equal to or greater than 60 percent for ¼ minute from the No. 2 blast furnace (violation of 25 PA Code 123.41). USX responded in correspondence dated 12/5/88 which resolved this matter.

- On 1/20/89, PADER issued a notice of violation alleging VE violations at the open hearth shop. The notice further alleged that temporary operating permit No. 09-307-016 had expired on 4/30/87, resulting in violation of 25 PA Code

§127.21, operating without a permit. USX addressed the matter in correspondence dated 5/23/89 referring to an 8/17/87 meeting in which PADER allowed flexibility in the operation of the open hearth shop.

- On 5/8/89, Falls Township notified USS of violations to the township code under BOCA/NFPA (1987) alleging improper storage of drums containing oil and grease on the property acquired by Waste Management of Pennsylvania. Further violations of regulations were alleged under Title 25, Chapter 75 regarding: (1) storage, handling, discharge, or disposal of certain combustible liquids without required permit; (2) the proper labeling of containers; and (3) requirements for the safe disposal or replacement of defective (leaky) containers. The Township required documentation that proper steps were taken in this regard. USS provided the documentation in correspondence dated 5/30/89.

- On 8/22/89, PADER issued a notice of violation alleging opacity readings equal to or greater than 20 percent for more than 3 minutes in 1 hour from the open hearth electrostatic precipitator (violation of 25 PA §123.41). USX responded in correspondence dated 8/28/89, which resolved the matter.

- Civil Action No. 890371, *United States v. USX*, was filed on 2/13/89. This action sought injunctive relief and civil penalties for certain past and continuing alleged violations of the Pennsylvania SIP and Section 110 (a) and (c) of the Clean Air Act, 42 U.S.C. §7510 (a) and (c). The complaint alleged emissions violations at Fairless Works blast furnaces Nos. 2 and 3, open hearth secondary electrostatic precipitator stack, and the sinter plant (opacity and mass rate). PADER joined the federal lawsuit as intervenor. Due to the closure of the sinter plant and subsequently the hot end in 1991, these alleged violations are no longer applicable. A consent decree with PADER and EPA resolved past issues.

- In a case pending in the U.S. District Court, Eastern District of Pennsylvania, a Consent Decree was executed by the United States of America and the Corporation and also by Intervenors Commonwealth of Pennsylvania; State of New Jersey; and City of Bordentown, New Jersey. The decree was approved by the court on 6/17/81. The decree settled two civil actions pending in that court with respect to facilities at Fairless Works. The decree also resolved outstanding litigation by the Commonwealth of Pennsylvania against the Corporation and a copy of a settlement agreement with the Commonwealth was attached to the decree.

  The decree covered programs for compliance at several facilities at Fairless Works, i.e., the sinter lines; blast furnace cast houses; emissions of sulfur dioxide, including such emissions from coke oven gas; and tapping emissions from the open hearth shop. The decree also provided for constructing control facilities beyond requirements of existing regulations.

A separate agreement signed with the Commonwealth of Pennsylvania set forth requirements for emission control with respect to the electric furnace shop and that agreement is an exhibit to the settlement agreement with the Commonwealth referred to above. A separate agreement signed with the Commonwealth of Pennsylvania sets forth requirements for control of industrial waste impoundments at Fairless Works and that agreement is an exhibit to the settlement agreement with the Commonwealth referred to above.

As a result of the consent decree, the following litigation was terminated:

1. The suit filed by the Commonwealth of Pennsylvania on 5/9/73 in the Court of Common Pleas of Bucks County, Pennsylvania, under state law seeking a preliminary and mandatory injunction for alleged air and water pollution violations at the Corporation's Fairless Works.

2. The suit filed by PADER on 9/17/75 before the Pennsylvania Environmental Hearing Board alleging violation of air pollution regulations at the Fairless Works sinter plant.

3. The two suits filed by the EPA on 10/18/79 and on 2/22/80 in the U.S. District Court, Eastern District of Pennsylvania, alleging air pollution violations at the blast furnaces, sinter lines, open hearth shop, electric arc furnace shop, coke oven batteries, including coke oven gas sulfur content at Fairless Works. In the first of these suits, the State of New Jersey, the City of Bordentown, New Jersey, and the Commonwealth of Pennsylvania were granted permission to intervene.

4. The suit filed on 6/22/79 by PADER before the Pennsylvania Environmental Hearing Board relating to alleged air pollution violations and relating to alleged water pollution violations from industrial waste impoundments at Fairless Works.

- Pursuant to SICEA, the United States as plaintiff, the City of Bordentown, New Jersey, the State of New Jersey, and the State of Pennsylvania as plaintiff-intervenors, and the Corporation signed a modification to the Consent Decree regarding the Corporation's Fairless Works, which was entered by the U.S. District Court on 2/17/83. Under the modification to the Consent Decree, the Corporation was obligated to install control facilities to resolve alleged air pollution problems.

- On 4/4/85 EPA issued a complaint against USX alleging violations of TSCA Section 6 (e) for failing to comply with the marking, storage, and use requirements for PCBs at its Fairless Works. The parties resolved the complaint by entering into a Consent Agreement and Consent Order dated 9/27/85.

- On 6/21/89, the Corporation entered into a Consent Decree with EPA and PADER to resolve past NPDES violations at Fairless Works and to set forth a corrective action program at each facility.

- On 2/20/91, the Corporation submitted a proposed Settlement Agreement to the Pennsylvania Fish Commission to resolve a threatened complaint regarding oil and grease discharges from the Terminal Treatment Plant at Outfall No. 103.

The following is a summary of Administrative Orders, Consent Agreements, Consent Adjudications, Settlement Agreements, Convictions, or Permit Revocations related to Pennsylvania solid waste facilities or activities at Fairless Works.

- On 2/15/81, the Corporation entered into a Consent Order and Agreement with PADER concerning the use of waste impoundments at Fairless Works. The order provided for the elimination of the use of the impoundments for waste disposal and the construction of replacement disposal facilities.

- On 8/22/85, the Corporation and PADER signed a Consent Decree that was lodged with the Commonwealth Court of Pennsylvania. The terms of the consent decree required the Corporation to remedy such violations and to comply with all applicable environmental laws and regulations.

- On 6/25/86, EPA issued a complaint against the Corporation alleging certain violations of RCRA regarding groundwater monitoring at Fairless Works. The parties reached a tentative agreement that required the Corporation to pay a civil penalty and to install a groundwater monitoring system approved by PADER and the EPA.

The following is a summary of Notices of Violation issued by PADER, Bucks County, or the EPA to USX Corporation.

- On 9/27/83, PADER issued a notice of violation alleging that the plant was failing to comply with the groundwater monitoring requirements under the hazardous waste regulations. On 11/16/83, the Corporation replied indicating that it was in compliance with the regulations.

- On 12/13/83, PADER issued a notice of violation alleging certain violations of the Pennsylvania hazardous waste regulations. By letter dated 2/7/84 the Corporation responded to the violations indicating that corrective measures would be implemented where necessary to ensure compliance.

- On 11/26/84, the Bucks County Department of Health issued a notice of violation alleging exceedances of NPDES water discharge limits. USX responded to this notice in correspondence dated 12/13/84, explaining the reason for the exceedances and the corrective action taken to prevent further violations.

- On 8/28/86 the County of Bucks Department of Health issued a notice of violation concerning first stage oxygen demand problems at Outfall Nos. 002 and 103. Also the notice of violation addressed chromium violations at Outfall No. 403. USX resolved this matter in correspondence dated 9/25/86.

- On 9/3/86 the Bucks County Department of Health issued a notice of violation alleging exceedances of NPDES limits for Outfall Nos. 002 and 103. USX responded to the Health Department in correspondence dated 9/25/86, explaining the reason for the exceedances and the corrective action to be taken.

- On 12/4/87 EPA issued a notice of violation (III-88-001-VA) alleging violations of the visible emission standard section of the Pennsylvania SIP at the facility's No. 2 windbox stack and at the open hearth secondary precipitator exhaust stack. Due to the closure of the sinter plant and subsequently the hot end in 1991, these alleged violations are no longer applicable. A consent decree with PADER and EPA resolved past issues.

- On 1/29/88 PADER issued a notice of violation alleging violations of an open hearth low emission operating procedure, §127.25 of PA Title 25 Rules and Regulations. Additionally, a violation was alleged at the secondary precipitator exhaust stating the VEs from the secondary stack were greater than 20 percent for more than 3 minutes per hour. Due to the closure of the sinter plant and subsequently the hot end in 1991, these alleged violations are no longer applicable. A consent decree with PADER and EPA resolved past issues.

- On 3/31/88, EPA issued a notice of violation (III-88-017-VA) alleging violations of the Pennsylvania SIP opacity regulations at facilities Nos. 2 and 3 blast furnace cast house roof monitors, the open hearth shop roof monitor and the sinter plant No. 4 Roto-Clone stack. Due to the closure of the sinter plant and subsequently the hot end in 1991, these alleged violations are no longer applicable. A consent decree with PADER and EPA resolved past issues.

- On 6/27/88 the County of Bucks Health Department issued a notice of violation concerning various permit violations (pH, oil and grease, and freeboard lagoon levels). USX responded in correspondence dated 7/8/88, which resolved this matter.

- In September, 1991, EPA issued a Complaint and Notice of Opportunity for Hearing to USX Corporation under the Toxic Substances Control Act 15 U.S.C. §2615. This complaint was settled by the signing of a Consent Agreement between USX Corporation and EPA in 1992 and payment by USX Corporation of a civil penalty of $65,000.

3.8.9 OSHA INSPECTIONS

According to the Fairless Works Safety Department, no OSHA inspections performed at the site after 1988 included information relevant to releases or spills.

3.9.10 PREVIOUS INVESTIGATIONS

A number of investigations of Fairless Works and the surrounding areas (G.R.O.W.S. Landfill and southeastern Bucks County) have been performed in the past. The following reports were used in generation of this document:

- Groundwater in the Coastal Plain of Pennsylvania (Greenman, *et al.*, 1961)

- Groundwater Investigation Report of Southeastern Bucks County and Adjacent Areas (L. Robert Kimball Consulting Engineers, 1976)

- Concept Report on Solid Waste Management (Chester Engineers, 1981)

- Report on Solid Waste Management Units (Baker/TSA, 1985)

- Closure Plans for Borrow Pits (Baker/TSA, Inc., 1986)

- WMNA Fairless Landfill, Phase I Application for Permit Modification, Volumes 3 and 4 (Chester Engineers, 1988)

- USX Site Evaluation Fairless Works, Morrisville, Pennsylvania, Volumes 1 through 5 (Golder Associates, Consulting Geotechnical and Mining Engineers, 1988).

- Fairless Works Sinter Plant Alternative Emission Reduction Plan (Energy & Environmental Management Inc., 1989)

- Silt and Surface Dust Loading on Roads at Fairless Works During April, 1988 (Energy & Environmental Management Inc. 1988)

- Tank Closure Report (Norbec Environmental Limited, 1991)

- Preliminary Hydrogeologic Investigation, Ore Hull (Norbec Environmental Limited, 1991)

- Environmental Investigation of Fairless Pipe Mill (Waste Technology, 1992)

- Environmental Investigation of Fairless Bar Mill Warehouse and Office Area (Waste Technology, 1992)

- Tank Closure Report (Norbec Environmental Limited, 1992)

- Third Quarter 1992 Groundwater Data (Earth Sciences Consultants, Inc., 1992)

- Fourth Annual Groundwater Data Evaluation and Third Quarter 1992 Groundwater Data (Earth Sciences Consultants, Inc., 1992)

- Results of Phase II and the Storm Water Project (UEC Environmental Systems, Inc. 1992)

The Groundwater Investigation Report of Southeastern Bucks County and Adjacent Areas (Kimball, 1976) purpose and scope provided a summary of published information relative to the groundwater regime and quality in the vicinity of Fairless Works.

The Concept Report on Solid Waste Management (Chester Engineers, 1981) provides a scope of work with two separate task elements. The first element was to recommend appropriate measures to bring existing borrow pits into compliance with environmental regulations. The second was to assist U.S. Steel in acquiring applicable permits and to design disposal sites for all solid wastes generated by Fairless Works.

Report on Solid Waste Management Units (Baker/TSA, 1985) presents information on all known solid waste management units. The units observed at the site for this report include: borrow pits, spent pickle liquor tanks, waste storage tanks, the Terminal Treatment Plant, and waste metal and slag storage areas.

Closure Plans for Borrow Pits (Baker/TSA, 1986), provides a plan for closure of the fifty-one earthen impoundments or borrow pits within Fairless Works. The outline for closure of each borrow pit presented in the Baker/TSA report is as follows:

- General Description
- Location

- Type and Quantity of Waste Disposed
- Run-on and Runoff
- Specific Closure Plan for each Borrow Pit

The Chester Engineers (1988) report for Waste Management of North America (WMNA), Fairless Landfill, Phase I Application for Permit Modification, Volumes 3 and 4, studied one of the land parcels that Waste Management was considering for purchase from USX. The report studied the feasibility of permitting the land as a municipal waste disposal area. The report also studied the request for approval to dispose processed infectious or chemotherapeutic waste streams. Other topics discussed include geology and hydrogeology, water supply, public water supply, surface water, and soils.

USX Site Evaluation, Fairless Works, Morrisville, Pennsylvania, Volumes 1 through 5 (Golder Associates, 1988) report evaluated geotechnical and hydrogeological baseline environmental conditions pertinent to the proposed purchase of USX land by WMI Properties, Inc. This report contains a geotechnical and hydrogeologic assessment of Fairless Works, emphasizing potential land acquisition areas and other pertinent areas that could potentially impact acquisition areas. The condition of soil and groundwater was addressed and possible sources of contamination were discussed.

The Alternative Emission Reduction Plan (Energy & Environmental Management Inc., 1988) describes U.S. Steel's plans for emission trading as provided by EPA's Emission Trading Policy in effect at that time. The report discusses site activities to reduce PM_{10} emissions under the Bubble program to offset emissions from the sinter plant.

Silt and Surface Dust Loading on Roads at Fairless Works During April, 1988 (Energy & Environmental Management Inc., 1988) discusses sampling activities performed to evaluate PM_{10} emissions resulting from traffic on unpaved roadways at Fairless Works. This work was performed to support the application for permission to operate the singer plant as part of the Bubble program by offsetting emissions from other portions of the facility.

The Tank Closure Report (Norbec Environmental, 1991) evaluated soil contamination in a tank pit following removal of two 4,000-gallon tanks that contained diesel fuel. These tanks were located in the Ore Hull area northwest of the blast furnaces.

The Preliminary Hydrogeologic Investigation (Norbec Environmental, 1991) involved soil sampling, monitoring well installation, and groundwater sampling for the area where the two 4,000-gallon underground diesel tanks were located. This investigation was the result of the earlier Tank Closure Report.

The Environmental Investigation report of the Fairless Pipe Mill (Waste Technology, 1992) summarized the investigation of the property and buildings associated with the pipe mill operation to establish an environmental baseline. Included in this investigation were surface soil, liquid, and sediment sampling, monitoring well installation, and groundwater sampling, as well as reviewing existing background information.

The Environmental Investigation report of the Fairless Bar Mill Warehouse and Office Area (Waste Technology, 1992) summarized the investigation of the property and buildings associated with the Bar Mill warehouse and office to establish an environmental baseline. Included with this investigation was soil, groundwater, paint, dust, asbestos, and sediment sampling.

The Tank Closure Report (Norbec Environmental Limited, 1992) evaluated soil and groundwater samples collected following the removal of three underground storage tanks in an area presently leased by C. J. Langenfelder & Son, Inc. This area is located north of BP-30 and BP-31A.

The Third Quarter 1992 Groundwater Data Report (Earth Sciences Consultants, Inc. 1992) presents sampling results for the third quarter of 1992 for Slag Disposal Area B and Borrow Pit 20. In addition, this report contains historical data for these wells from 1980.

The Fourth Annual Groundwater Data Evaluation and Third Quarter 1992 Groundwater Data Report (Earth Sciences Consultants, Inc., 1992) presents third quarter 1992 sampling results and historical analytical results from October 1988 for the USX Corporation/Waste Management, Inc. property transaction.

The Results of Phase II of the Storm Water Project (UEC Environmental Systems, 1992) provides information on the surface drainage at Fairless Works and concludes that storm water from the site is currently discharged through NPDES-permitted outfalls.

3.10.11 INTERIM MEASURES AND RELATED ACTIVITIES

During the operating years of Fairless Works, a number of activities to reduce releases to the environment have occurred. Some of these activities were considered routine maintenance and others were in direct response to changes in regulatory requirements. Other activities that were performed could be considered interim measures and those activities are discussed in this section.

In response to concerns expressed by the U.S. Fish and Wildlife Service, U.S. Steel made a significant effort to reduce the potential for exposure of wildfowl to oil on the surface water in the Borrow Pit 35 complex and the Terminal Treatment Plant Lagoons. This activity included several elements. To discourage wildfowl from entering the BP-35 area, two propane cannons were installed and continue to operate. These cannons are periodically moved to prevent the wildfowl from becoming accustomed to the noise. In addition, two oil skimmers are operated at opposite ends of the borrow pit to allow skimming to occur whenever the wind conditions move the oil to one end or the other. They generally do not operate simultaneously as a result. To further discourage wildfowl from residing in the area of BP-35, habitat management has also occurred to make the area less attractive to the wildfowl.

The TTP lagoons were also identified as an area of concern by the Fish and Wildlife Service. To prevent wildfowl entry into the inactive lagoons (Lagoons 1, 2, and part of 4), netting was placed over the lagoons. The active portion of lagoon 4 was also netted. In addition, habitat management was performed in the TTP area to make the area less attractive to wildfowl.

As part of the RCRA process, Borrow Pit 20 which received an interim permit was closed in accordance with regulatory requirements. The BP-20 closure is discussed in Section 4.1.19 of this report in more detail. In general, the closure plan called for consolidation of certain waste materials in a portion of BP-20 and installation of a RCRA cap to prevent infiltration through the waste materials. This closure was completed and the post-closure monitoring is ongoing.

In the late 1980s and early 1990s, U.S. Steel undertook a general cleanup of surface debris throughout Fairless Works. The materials that were collected and disposed offsite included tires, empty drums, wood, and other general refuse. For example, the 1992 Residual Waste report for Fairless Works lists 39,500 pounds of used tires, 2,300,000 pounds of industrial trash, 9,860,000 pounds of hot end cleanup materials.

U.S. Steel has in place a site-wide program to remove or retrofit PCB transformers throughout Fairless Works. As demonstrated by the Transformer inventory in Appendix B, over 70 percent of the PCB transformers have been removed from service in accordance with TSCA regulations.

4.0 ASSESSMENT AND EXTENT OF CONTAMINATION

4.1 DESCRIPTION, LOCATION, AND EXTENT OF CONTAMINATION OF SOLID WASTE MANAGEMENT UNITS

Sixty-eight areas where wastes have been stored, processed, landfilled, or impounded have been identified on the U.S. Steel Fairless Works site. Of these, 48 were specifically identified as Solid Waste Management Units (SWMUs) in the Draft Phase I RFA Report prepared for the EPA by Environmental Science and Engineering, Inc. The identified SWMUs include borrow pits (landfills or surface impoundments) and waste handling and storage areas (the FMTP, TTP, and Rod Mill Settling Lagoon). Process wastes stored in these areas include: coke wastes, iron-making wastes, steel-making wastes, finishing wastes, wastes from various water treatment processes, and general plant refuse. The identified SWMUs are shown in Figure 3. This figure also shows other SWMUs and areas of concern. Table 10 summarizes all soil, surface water, and groundwater samples that have been collected and the parameters each was analyzed for. Analytical results for soil from previous investigations are found in Appendix D. Appendix E contains the analytical results for groundwater from previous investigations. Surface water analytical results from previous investigations are found in Appendix F. The FMTP, TTP, and Rod Mill Settling Lagoon are described in Section 3.2.3.2.

A summary of the waste type and estimated volume disposed of in each borrow pit is found in Table 11. The following sections discuss each of the borrow pits individually. Locations where data are available are identified in each section, and the data are provided in the appendices. The monitoring wells that are identified in the following sections were selected primarily on the basis of proximity to individual borrow pits; in most cases, the wells were not installed expressly to monitor those pits. In some cases, there is not sufficient groundwater elevation data to determine which wells are upgradient or downgradient from individual pits and it is therefore not always possible to determine whether a particular pit is a potential source of groundwater impacts.

Groundwater data, where available, have been compared to current (1993) and proposed (1994) Maximum Contaminant Levels (MCLs) from the Safe Drinking Water Act. This comparison has been performed to provide some quantitative evaluation of the impact to groundwater at the site. The MCLs are drinking water standards for human consumption (i.e., after water treatment and applied at the consumer's tap) and, therefore, represent conservative levels for this comparison because groundwater on the U.S. Steel site is not and will not be used for drinking purposes. Where groundwater data is consistently below or near these levels and there is no evidence of a release potentially threatening human health or the environment, U.S. Steel believes that no further action is necessary. Where groundwater data exceed these drinking water levels, further evaluation of the risk associated with the release is necessary to determine whether or not the release potentially threatens human health or the environment. These evaluations will be made as part of the RFI.

4.1.1 BP-2 North

BP-2 North is located immediately south of the general plant offices and southeast of the central shops. This pit was rectangular in shape and occupies approximately 37 acres. This pit received slag, waste from railroad track cleanup (coal fines), and general refuse (waste brick, lumber, discarded tires). It was active from 1968 until 1975 and is now filled to grade. Canal No. 2 traverses the western edge. Groundwater data were collected from wells 48, 66, and 67 in 1981 (Chester Engineers, 1981). No constituents were detected at concentrations exceeding current (1993) maximum contaminant levels (MCLs). There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action to address groundwater is necessary. Since this pit is filled to grade, there is no potential for exposure to surface water.

4.1.2 BP-2 South

BP-2 South is located east of the open hearth furnaces and west of the rolling mill. It is separated from BP-2 North by a roadway. This pit was an irregular rectangle covering approximately 65 acres. This pit received slag and general refuse, including metal scrap, railroad ties, and discarded tires. It was active from 1968 until 1975 and is now filled to grade. Canal No. 2 traverses the western edge and a ditch in the northern portion runs east to west and drains into Canal No. 2. The air separation plant was built on the northeast corner of BP-2 South. This area was also once used as the slab yard. Groundwater data were collected from wells 26 and 27 in 1981 (Chester Engineers, 1981). No constituents were detected at concentrations exceeding current (1993) MCLs. There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action to address groundwater is necessary. Since this pit is filled to grade, there is no potential for exposure to surface water.

4.1.3 BP-3

BP-3 is located east of the blast furnaces and south of the open hearth furnaces. This pit is an irregular triangle covering approximately 85 acres. It was used from at least 1972 until 1987. Part of the pit is filled with flue dust, slag, and other materials. About 20 percent of BP-3, located within the central portion, is filled with water. Dikes have been constructed to divide it into various sections.

This pit received limited runoff from adjacent areas in addition to waters derived from the dewatering of sludges and slurries. Excess water was periodically pumped to Canal No. 2 and to the Terminal Treatment Plant (TTP).

BP-3 received numerous wastes, including open hearth electrostatic precipitator (ESP) dust, ore washing fines, sinter plant dusts and sludges, blast furnace flue dust, blast furnace thickener filter cake, electric furnace dusts, blast furnace slag pit quench water, API separator underflow, and some general refuse. Before shutdown, blast furnace flue dust, sinter plant sludge, and API separator underflow were removed and recycled to the sinter plant, for further steel-making processes. Groundwater data were collected from wells 16, 17, 18, 22, and 58 in 1981 (Chester Engineers, 1981). No constituents were detected at concentrations exceeding current (1993) MCLs with the exception of one sample from well 18, which slightly exceeded the proposed MCL for nickel. Groundwater samples were collected from one upgradient well (16) and five downgradient wells (17, 18, 22, 27, and 58) during quarterly sampling rounds from 1983 to 1985. Mercury exceeded the MCL only in the background well during the third quarter 1983. Cadmium exceeded the MCL in the second quarter in well 27. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.4 BP-4

BP-4 is located southwest of the central shops and north of the open hearth furnaces. This pit is irregularly shaped and occupies approximately 107.6 acres. This pit received slag and general plant refuse, including metal scrap, railroad ties, and brick. It was active from 1957 until the early 1980s, when it was largely filled in. The site was then used for storage and reclamation of slag, scrap pipe, and iron. Most of the pit is now filled to grade. Groundwater data were collected from wells 12, 13, 48, 49, 68, and 69 in 1981 (Chester Engineers, 1981). No constituents were detected at concentrations exceeding current (1993) MCLs. One sample from well 12 slightly exceeded the proposed MCL for cyanide. There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action to address groundwater is necessary. However, due to the presence of open water, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.5 BP-5A

BP-5A is located south of the coke plant and north of the blast furnace slag reprocessing area. The pit is rectangular in shape and covers approximately 6.9 acres. BP-5A has received slag, coal fines from the coal car dumper, recycled blast furnace slag quench water, and some general refuse. Some of the slag has been removed for recycling. It was active from 1952 until 1984. The northern half is now filled to grade; the southern half is covered by standing water. Groundwater data were collected from well 14 in 1981 (Chester Engineers, 1981) and wells FUB10D and FUB11 in 1992 (Earth Sciences, 1992). No constituents were detected at concentrations exceeding current (1993) MCLs. There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action to address groundwater is necessary. However, due to the presence of open water, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.6 BP-8

BP-8 is located northwest of the blast furnaces and east of the blast furnace slag reprocessing area. This pit is rectangular in shape and covers approximately 14.4 acres. This pit received slag. It was active from 1952 until 1965 and is now filled to grade. After being filled, it was used for iron ore and limestone storage. Groundwater data were collected from well 57 in 1981 (Chester Engineers, 1981). Additional groundwater data were collected in wells MW-1, MW-2, and MW-

3 in 1991 (Norbec, 1991). These wells were installed as part of an ongoing project to remove underground storage tanks that belong to a contractor. Any further remediation associated with these tanks will be handled by the contractor. Wells FUB14, FUB15D and FUB16 were sampled in 1992 (Earth Sciences, 1992). No constituents were detected at concentrations exceeding current (1993) MCLs. There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action to address groundwater is necessary. Since this pit is filled to grade, there is no potential for exposure to surface water.

4.1.7 BP-8A

BP-8A is located to the north of the blast furnaces, south of the coke plant, and west of the open hearth furnaces. It is a triangular pit approximately 1.2 acres in size; permanent standing water covers approximately 0.6 acres. The portion of the pit not covered by water is sparsely vegetated.

This pit was active from 1952 to 1984, during which time it was used to impound emergency overflows of quench water from the coke quenching station and for the disposal of tar sludge, coke breeze, and some slag. Some coal tar was removed from BP-8A during the closure of BP-20. Coke breeze and slag have also been dumped around the perimeter of the pit. Soil analyses from this pit (Golder, 1988) indicated detected levels of oil and grease and barium (as a leachate). Groundwater data were collected from wells 55 and 56 in 1981 (Chester Engineers, 1981). No constituents were detected at concentrations exceeding current (1993) MCLs. The sample from well 55 exceeded the proposed MCL for cyanide. In addition, TOC, oil and grease, and phenols were detected. More recent data (Golder, 1988) for well 55 indicated the presence of benzene and lead at levels exceeding MCLs. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.8 BP-8B

BP-8B is located south of BP-8A. This pit is rectangular in shape and occupies approximately 7 acres. It was active from 1952 until 1984. BP-8B received slag, coal fines from the coal conveyor pit sump, and some general refuse (waste brick, railroad track maintenance debris). A small quantity of tar sludge may have been placed on the dike separating BP-8B from BP-8A. Approximately two thirds of BP-8B has been filled to grade with slag in the southern portion, with standing water covering the remaining northern portion of the pit. Soil analyses in this pit (Golder, 1988) indicated detected levels of oil and grease, barium (leachate), and cadmium (leachate). Groundwater data were collected from wells FUB12 and FUB13 in 1992 (Earth Sciences, 1992). Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.9 BP-9

BP-9 is located immediately to the north of the blast furnaces. This pit is an irregular rectangle which covers approximately 16.6 acres. This pit received slag and ladle house debris. It was active from 1952 until 1965, when the southern part was filled to grade. Once filled, the pit was used for iron ore storage; shallow standing water covers approximately 10 acres of the northern portion of the pit. Groundwater data were collected from wells 51, 57, and 58 in 1981 (Chester Engineers, 1981). The sample from well 51 slightly exceeded the proposed MCL for cyanide. There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action to address groundwater is necessary. However, due to the presence of open water, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.10 BP-10

BP-10 is located northeast of the blast furnaces and southwest of the open hearth furnaces. This pit is a rectangle that occupies approximately 1.9 acres. It was active from 1952 until 1957 and is now filled to grade with slag. Groundwater data were collected from wells 17 and 73 in 1981 (Chester Engineers, 1981). The sample from well 17 exceeded the proposed MCL for manganese. There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action to address groundwater is necessary. Since this pit is filled to grade, there is no potential for exposure to surface water.

4.1.11 BP-10A

BP-10A is located immediately to the west of the open hearth furnaces. It is an irregular triangle in shape and covers approximately 1 acre. It was active from 1952 until 1967 and is now filled in and paved over for use as a parking lot. BP-10A was filled to grade with slag. Groundwater data were collected from well 51 in 1981 (Chester Engineers, 1981). The sample from well 51 exceeded the proposed MCLs for cyanide and manganese. There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action to address groundwater is necessary. Since this pit is filled to grade, there is no potential for exposure to surface water.

4.1.12 BP-10B

BP-10B is located north of the blast furnaces and south of the open hearth furnaces. It is rectangular in shape and covers approximately 2.1 acres. BP-10B is partially filled with slag. Standing water occupies most of the pit. This borrow pit also received overflow from the industrial sewer system and the pit is oil stained. Groundwater data were collected from well 58 in 1981 (Chester Engineers, 1981). No constituents were detected at concentrations exceeding current (1993) MCLs. However, due to the visible staining, US Steel believes that additional evaluation is appropriate.

4.1.13 BP-13

BP-13 is located southeast of the coke plant and west of the open hearth furnaces. It is irregular in shape and occupies approximately 6 acres. BP-13 received steel-making slag, ladle house solid wastes, contractors' painting solid wastes, and tar decanter sludge from the coke plant. The proportion of tar decanter sludge is reported to be low. This pit was active from 1952 until 1978, when it was filled to grade. Once filled, it was used as a coke storage area. Groundwater data were collected from well 51 in 1981 (Chester Engineers, 1981). The sample from well 51 exceeded the proposed MCL for cyanide. Additional data from well 89 was reported in 1987 (Golder, 1988). The sample from well 89 contained benzene, toluene, and phenol. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.14 BP-13A

BP-13A is located to the east of the coke plant and northwest of the open hearth furnaces. It is an irregularly shaped pit which covers approximately 2.1 acres. This pit was active from 1952 until 1976 and was used to impound emergency overflows of coke plant process wastewater and phenol-bearing spent caustic solution from the dephenolizer. Some concrete demolition debris was also disposed in this pit. Releases of tar from the coke works tar tanks are also evident around this pit. Permanent standing water covers the southern half of the pit; the northern half is filled to grade. Groundwater data were collected from wells 11, 12, and 13 in 1981 (Chester Engineers, 1981). The sample from well 13 exceeded the proposed MCL for cyanide. Additional data (Golder, 1988) indicated elevated lead concentrations in well 13. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.15 BP-14 (North and South)

BP-14 is located immediately to the north of the coke plant. This pit has been divided into two sections (North and South) which occupy a combined area of approximately 8.3 acres. These pits received slag and various coke plant wastes, including ammonia still lime sludge, coke plant wastewater, and phenol-bearing spent caustic solution from the dephenolizer. These pits were active from 1952 until 1984. They are at present partially filled in. BP-14 North contains approximately 1 acre of impounded water in its northern portion; BP-14 South is filled to grade with the exception of the southern portion, which is covered with approximately 1.2 acres of standing water. Soil analyses from this pit (Golder, 1988) showed detected levels of oil and grease. Groundwater data (Chester Engineers, 1981; Golder, 1988; Chester Engineers, 1988; and Earth Sciences, 1992) from wells 5, 6, 7, 54, 71, 90, and FUB01 indicate elevated concentrations of benzene, toluene, phenol, cyanide, and metals. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.16 BP-15

BP-15 is located northwest of the coke plant. It is an irregular rectangle covering approximately 12.3 acres. This pit was active from 1952 until 1975. During this time, it received slag and possibly other materials. It is now filled to grade. Groundwater data (Chester Engineers, 1981;

Golder, 1988 Chester Engineers, 1988; and Earth Sciences, 1992) were collected from wells 5, 7A, 8, 9, 9A, 10, FUB02, FUB03, FUB04, and FUB05D. Benzene and PCBs exceed MCLs in well FUB05D in 1992. Elevated metals were detected in well 7A. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.17 BP-17

BP-17 is located north of the coke plant and west of the central shops. This pit is an irregular rectangle that occupies approximately 15.8 acres. BP-17 has received slag and general refuse, including railroad ties, tires, scrap lumber, and trash. The impounded water contains elevated concentrations of ammonia, cyanide, and phenolics. Approximately half of the pit has been filled to grade; the remainder is covered by impounded water, primarily in the northern section and along the western edge. BP-17 was active from 1952 until 1976. Soil analyses from this pit (Golder, 1988) showed detected levels of oil and grease. Groundwater (Chester Engineers, 1981; Golder, 1988) from wells 7 and 70 indicate detectable concentrations of benzene, trans-1,2-dichloroethene, naphthalene, and phenol. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.18 BP-19

BP-19 is located immediately to the north of the bar mill. This pit is rectangular in shape and covers an area of approximately 2.3 acres. It was active from 1952 until 1958 and is now filled to grade with slag. Groundwater data from wells MW-1, MW-2, MW-3, and MW-4 (Waste Technology, 1992), associated with the Bar Mill Warehouse and office investigation, showed only cadmium and lead exceeding MCLs in well MW-4. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.19 BP-20

BP-20 was excavated during plant construction in the early 1950s. In August 1981, it was permitted as a RCRA interim status hazardous waste disposal unit. This status was terminated in January 1983, when disposal activities ceased. This pit is located to the north of the coke plant and is roughly rectangular in shape. It covers an area of approximately 12.3 acres and is about 75 percent filled with slag.

Between 1972 and 1977, this pit began receiving slag. Between 1980 and January 1983, it was used for the disposal of decanter tank tar sludge. It also contained some general refuse, including discarded tires, scrap iron, and wood debris.

BP-20 did not receive any decanter tank tar sludge after January 26, 1983. A closure plan was submitted by U.S. Steel for BP-20 in June 1983 (Chester Engineers) with final approval from PADER given on June 26, 1988. Construction activities for closure began on August 29, 1988, and were completed by December 20, 1988.

Soil analyses from this pit (Golder, 1988) showed detected levels of mercury (leachate) and oil and grease.

Presently, 13 monitoring wells surround the capped area of BP-20. These wells are grouped into four well clusters (TB-1, TB-3, TB-4, and TB-5) with two to four wells in each cluster screening different depths below the surface. These wells are sampled quarterly as required by the Closure Plan. Of the four well clusters, only wells screened in the upper (water table) aquifer are included in the monitoring program. Water level data from these wells indicate that the hydraulic gradient is generally to the east or southeast in the vicinity of BP-20. Minimal vertical gradients in both the upward and downward directions have been observed (Earth Sciences Consultants, 1993).

The upgradient well cluster (TB-1) is screened in four intervals. These wells contain concentrations of methoxychlor, radium 226, barium, and mercury above their MCLs. Vinyl chloride, methylene chloride, and 1,2-dichloroethane were also detected in selected intervals.

The downgradient wells (TB-3A, TB-3C, TB-4A, TB-4B, TB-4C, TB-4D, TB-5A, TB-5B, and TB-5C) all contain concentrations above MCLs of methylene chloride, vinyl chloride, methoxychlor, barium, and mercury. Other compounds detected in selected intervals include radium 226, selenium, chromium, nickel, 1,1-dichloroethane, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and phenols. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.20 BP-21

BP-21 is part of a borrow pit complex consisting of BP-21, BP-31, and BP-31A. It is located northwest of the coke plant and northeast of the former National Can Corporation facility on property that is now owned by Wheelabrator Environmental Systems. It is irregular in shape and occupies an area of approximately 30.7 acres. BP-21 received blast furnace slag. This pit was active from 1952 until 1980 and is now largely filled in. Its southwest corner is filled to grade and part of the former National Can Corporation facility is constructed on it. A report that summarized groundwater conditions in the vicinity of BP-21 (BCM, 1992) concluded that the borrow pit is not a source of releases to groundwater. A copy of this report is included in Appendix G. There is no evidence of a release potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action is necessary.

4.1.21 BP-23, BP-24, BP-25

Borrow pits 23, 24, and 25 form a contiguous complex that is located immediately to the north of the sheet and tin facility. This area is triangular in shape and covers approximately 31 acres. A portion of the northeast corner (approximately 8.3 acres) has been filled to grade with slag and is used as a parking lot. There is no permanent standing water in this complex. Groundwater data were collected from wells 39, 41, and 53 in 1981 (Chester Engineers, 1981). There is no evidence of a release potentially threatening human health or the environment associated with this SWMU and therefore no further action is necessary.

4.1.22 BP-26

BP-26 is located beneath the northeast portion of the sheet and tin facility. This pit is an irregular rectangle that covers approximately 4.8 acres and portions were active from 1952 until 1965. The pit is now filled to grade with slag. Groundwater data were collected from well 40 in 1981 (Chester Engineers, 1981). The sample from well 40 exceeded the proposed MCL for nickel. There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action to address groundwater is necessary. Since this pit is filled to grade, there is no potential for exposure to surface water.

4.1.23 BP-27

BP-27 is located southeast of the main gate and northwest of the central shops. It is an irregular rectangle that occupies approximately 9 acres. This pit received slag, railroad car and track maintenance wastes, and some wood debris. The amount of waste that was disposed in this pit is reported to be minimal. This pit was active from 1952 until 1980 and is now filled with standing water. Groundwater data were collected from well 45 in 1981 (Chester Engineers, 1981). The sample from well 45 exceeded the proposed MCL for nickel. Wells MW-1, MW-2, and MW-3, which were installed as part of a tank closure project on land leased by a contractor (Norbec, 1992), are located upgradient of BP-27. These wells showed levels of benzene, toluene, and ethylbenzene that exceed MCLs. TPH levels were also elevated. Any further remediation associated with the tank closure project will be handled by the contractor. Although this SWMU is not suspected of being a source of a release to the environment, due to the presence of open water, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.24 BP-29

BP-29 is located immediately to the east of the Main Gate along the south bank of Biles Creek. It is rectangular in shape and occupies approximately 1.4 acres. This pit was active from 1952 until 1958 and is now filled to grade with slag. The nearest well to this borrow pit (44) is most likely upgradient. There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action to address groundwater is necessary. Since this pit is filled to grade, there is no potential for exposure to surface water.

4.1.25 BP-30

BP-30 is located northwest of the pipe mill along the south bank of Biles Creek. This pit is rectangular in shape and occupies approximately 1.4 acres. It was active from 1952 until 1958 and is now filled to grade with slag and dredge spoils. The nearest well to this borrow pit (39) is most likely upgradient. There is no evidence of a release potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action is necessary. Since this pit is filled to grade, there is no potential for exposure to surface water.

4.1.26 BP-31

BP-31 is located north of the former National Can Corporation facility and southeast of the former American Can Company facility on property that is now owned by Wheelabrator Environmental Systems. It is part of a borrow pit complex that includes BP-21 and BP-31A. This pit is an irregular rectangle that occupies approximately 18.8 acres. BP-31 received blast furnace slag. It was active from 1952 until 1980. The majority of the borrow pit is filled to grade; the eastern edge contains impounded water that supports wetlands vegetation. A report that summarizes groundwater conditions in the vicinity of BP-31 (BCM, 1992) concluded that the borrow pit is not a source of releases to groundwater. A copy of this report is included in Appendix G. There is no evidence of a release potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action is necessary.

4.1.27 BP-31A

BP-31A is part of a borrow pit complex that includes BP-21 and BP-31. It is located immediately to the southeast of the former American Can Company facility on property that is currently owned by Wheelabrator Environmental Systems. This pit is irregular in shape and occupies approximately 28.3 acres. This pit received blast furnace slag. The central portion (approximately 15 acres) is filled to grade. Impounded water occurs in the extreme eastern portion and along the northern edge. This pit was active from 1952 until 1980. A report that summarizes groundwater conditions in the vicinity of BP-31A (BCM, 1992) concluded that the borrow pit is not a source of releases to groundwater. A copy of this report is included in Appendix G. There is no evidence of a release potentially threatening human health or the environment associated with this SWMU and therefore, U.S. Steel believes that no further action is necessary.

4.1.28 BP-32

BP-32 is located north of the coke plant and west of the central shops. This pit is irregular in shape and covers an area of approximately 9 acres. This pit received slag and some general refuse, including metal scrap, railroad ties, construction debris, and a small quantity of material described as dried oil sludge. It was active from 1952 until 1974 and is now filled to grade except for a small area in the northeast corner. The southern portion of the pit contains a natural gas mixing facility, propane facility, and a storage yard for refractory material. Groundwater data were collected from wells 46 and 70 in 1981 (Chester Engineers, 1981). The samples from wells 46 and 70 exceeded the proposed MCL for nickel. Additional data (Golder, 1988) indicated that well 70 contained detectable concentrations of benzene, trans-1,2-dichloroethene, phenols, and metals. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.29 BP-33

BP-33 is located east of the East Canal and south of the rod mill lagoon. This pit has remained unused except for a small portion that was filled in with slag and used as a site for the construction of explosives magazines. The remainder of the pit has remained empty. Groundwater data were collected from well 61 in 1981 (Chester Engineers, 1981). No constituents were detected at concentrations exceeding current (1993) MCLs. There is no evidence of a release potentially threatening human health or the environment associated with this SWMU, and therefore U.S. Steel believes that no further action is necessary.

4.1.30 BP-35, BP-35A, BP-35B, BP-35C

This complex of borrow pits is located immediately to the south of the electric arc furnace and east of the Terminal Treatment Plant. Borrow pits BP-35, BP-35A, BP-35B, and BP-35C were used in series as sludge sedimentation/dewatering ponds for TTP sludge, underflow, and dredgings. These four pits have a combined area of approximately 9.1 acres. BP-35 contains impounded water and sludge. BP-35A contains impounded water and sludge. BP-35B is presently filled with partially dried sludge. BP-35C is filled to grade with dried sludge and supports vegetation. Oil from the TTP sludge floats to the surface of the water in those sections of the borrow pits that have standing water. An oil skimmer is currently in place to remove the floating oil. An Interim Measure Work Plan to address standing water and oil in these pits was submitted to EPA by U.S. Steel. Groundwater data were collected from wells 24, 24A, and 59 in 1981 (Chester Engineers, 1981). The samples from wells 24 and 59 exceeded the proposed MCL for nickel. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.31 BP-36

BP-36 is located on the north side of Biles Island on property that is no longer owned by U.S. Steel. It is an irregularly shaped pit that covers approximately 76.5 acres. This pit was active from 1952 until 1965 and is now filled to grade. It was used by the U.S. Army Corps of Engineers for the disposal of dredge spoils. The current owner, Waste Management of Pennsylvania, has a PADER permit to mine sand and gravel from the dredge spoils. This location is not part of the site and no further evaluation will be performed.

4.1.32 BP-37

BP-37 is located immediately to the north of the pipe mill along the south bank of the Delaware River. It is rectangular in shape and occupies approximately 32 acres. This pit received slag and dredge spoils. This pit was active from 1952 until 1965. This pit is the location of a former rifle range. The nearest wells (37, 79, MW-1, and MW-8) are most likely upgradient. There is no evidence of a release potentially threatening human health or the environment associated with this SWMU and therefore no further action is necessary.

4.1.33 BP-38

BP-38 is located immediately to the east of the pipe mill along the west bank of the Delaware River. It is an irregularly shaped pit whose area is undetermined. It was reportedly filled with slag and/or dredge spoils and was not used for disposal of other wastes. It is currently vegetated. Groundwater data (Chester, 1981; Golder, 1988) from wells 35, 78, and 86 indicated no constituents above current (1993) MCLs. The sample from well 35 exceeded the proposed MCL for nickel. There is no evidence of a release potentially threatening human health or the environment associated with this SWMU, and therefore U.S. Steel believes that no further action is necessary. Since this pit is filled to grade, there is no potential for exposure to surface water.

4.1.34 BP-40

BP-40 is located immediately to the east of the wire mill along the west bank of the Delaware River. This pit is irregularly shaped and occupies approximately 32.2 acres. BP-40 received slag, small amounts of acid rinsewater and borax from the wire mill, and general refuse, including metal scrap and construction debris. It was active from 1952 until 1980. Its northern half is unfilled. A small area (approximately 3.5 acres) in the southwest corner has been filled to grade; a portion of the wire mill facility was built on it. Groundwater data were collected from wells 76 and 77 in 1981 (Chester Engineers, 1981). No constituents were detected at concentrations exceeding current MCLs. There is no evidence of a release to groundwater potentially threatening human health or the environment associated with this SWMU, and therefore U.S. Steel believes that no further action to address groundwater is necessary. Since this pit is filled to grade, there is no potential for exposure to surface water.

4.1.35 NT-A

Borrow pit NT-A is located north of the bar mill and east of the sheet/tin mill. This pit is irregular in shape and occupies approximately 12.5 acres. This pit received slag, emergency overflows of process wastewater from the pipe mill hot forming and galvanizing operations (scale pit effluent), and a small amount of general refuse (waste lumber). It contains permanent standing water except for an area (approximately 4.8 acres) in the southwest corner that has been filled to grade and is used as a parking lot. Groundwater data were collected from well 64 in 1981 (Chester Engineers, 1981). No constituents were detected at concentrations exceeding current (1993) MCLs. Groundwater collected in 1992 (Waste Technology, 1992) from well MW-5 showed benzene to be above the MCL. MW-6, the presumed upgradient well, exceeded the lead MCL and the proposed beryllium MCL. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.36 NT-B

Borrow pit NT-B is located south of the pipe mill and north of the bar mill. This pit is a rectangle of undetermined area. This pit received waste brick and pipe mill debris. The period of time during which it was in use is not known. It is now fully filled in. Groundwater data (Golder, 1988) from the nearest well (34) indicated elevated chromium and isophorone. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.37 NT-2

Borrow pit NT-2 is located northwest of the pipe mill. It is irregular in shape and occupies approximately 12.4 acres. This pit received open hearth slag, pipe mill debris, refractory brick, and Class I demolition debris. In 1985, it was listed as active and permitted for slag disposal (Permit Number 300824). Slag disposal ceased in 1990. The pit is filled in the northern half and has standing water in the middle. Vegetation is present in the southern area. Groundwater data were collected from wells 38 and 79 (Chester Engineers, 1981; and Baker/TSA, 1985) and wells MW-8 and 79 in 1992 (Waste Technology, 1992). Well 38 exceeded MCLs for chloroform, chlorodibromoethane, and the proposed MCL for nickel (Chester, 1981). Well 79 also exceeded the proposed MCL for nickel (Chester, 1981). No MCLs were exceeded during the routine monitoring program between 1983 and 1985 (Baker/TSA, 1985). Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.38 NT-3

Borrow pit NT-3 is located east and south of the pipe mill. It is irregular in shape and covers approximately 32.6 acres. This pit received sludge from the FMTP. This sludge is derived from the pretreatment of sheet and tin process wastewaters. In addition, on limited occasions, it received lime stabilized spent pickle liquor, oily scale pit wastes collected by vacuum trucks, and a small amount of general refuse. This pit was active from 1980 until 1988. It is divided by a slag dike and the northern portion contains permanent standing water. The southern portion is partially covered by standing water in the very northern part and is only vegetated in the northern portion of the southern half. The remaining pit is filled to grade.

Soil analyses from this pit (Golder, 1988) showed detected levels of oil and grease (Appendix D).

Groundwater data were collected from wells 33, 34, 35, 36, 37 and 78 (Baker/TSA, 1985), wells MW-1, MW-2, and MW-3 in 1992 (Waste Technology, 1992), and wells FUA01D, FUA02D, FUA03, FUA04D, FUA05, and FUA06D in 1992 (Earth Sciences, 1992). Cadmium exceeded the MCL frequently in well 78 but only once in wells 34 and 36. These wells were sampled as part of a quarterly sampling event from 1983 to 1985. The cadmium levels found in the two background wells (34 and 36) were only detected on the last sampling event. Cadmium exceeded the MCL in MW-1, MW-2 and MW-3, chromium exceeded the MCL in MW-2 and MW-3. A background well for this borrow pit (MW-4) also showed that cadmium and chromium exceeded the MCLs. Well MW-3 also exceeded the proposed MCL for beryllium. Well FUA03 exceeded the proposed MCL for beryllium. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.39 NT-4

Borrow pit NT-4 is located north of the wire mill and east of the bar and rod mills. It is rectangular in shape and covers approximately 15.4 acres. From 1972 to 1977, this pit received oil skimmings from the FMTP and other locations on the site. After 1977, no further disposal of oil occurred and an outside contractor was used to reclaim the oil. The pit was then filled in with slag, building debris, and refractory brick. By 1980, it was filled to grade. Soil analyses from this pit (Golder, 1988) showed elevated levels of Arochlor-1248, oil and grease, barium (leachate), and lead (leachate). Groundwater data were collected from wells 32 and 33 (Chester Engineers, 1981) and MW-1, MW-2, MW-3, and MW-4 (Waste Technology, 1992). Nickel exceeded the proposed MCL in wells 32 and 33. Cadmium and lead exceeded the current (1993) MCLs in well MW-4. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

4.1.40 Other Borrow Pits

Other borrow pits that were not identified in the RFA report include the following:

- BP-1 - located beneath portions of the electric arc furnace, received wastewater slurry from the FMTP from 1952 until 1972 when the discharge was rerouted to BP-3. This pit is irregular in shape and occupies approximately 117 acres. It was active from 1952 until 1978. The majority of the pit is now filled to grade with the exception of the eastern portion which contains some impounded water. The majority of the pit was filled with slag. Based on the available data, U.S. Steel believes that additional evaluation of this area in the RFI is appropriate.

- BP-5 - located between BP-5A and the boat slip, never received solid waste and is now the West Canal. It is not a SWMU. BP-5 is located in Figure 14.

- BP- 28 A & B - were permitted for slag disposal as Area A by PADER (Permit No. 300824). No slag disposal occurred in these pits. A roadway was constructed of slag along the perimeter of these pits. The pits never received solid waste and are not SWMUs.

- BP- 39 - located between borrow pits BP-38 and BP-40, never received solid waste and is not a SWMU.

- NT - 1 - was a portion of permitted slag disposal Area B (Permit No. 300825) and is filled to grade with slag. This pit was roughly triangular in shape and occupied approximately 13 acres.

4.2 POTENTIAL MIGRATION PATHWAYS

A general description of the site geology, pedology, hydrogeology, physiography, hydrology, water quality, meteorology, and air quality are included as Sections 3.1.1 to 3.1.11. This information was gathered from a multitude of relevant, available literature sources and provides a preliminary understanding of site conditions on a broad, general basis. Absolute conclusions regarding potential migration pathways cannot be developed from these sources at this time. However, a review of the nature and extent of contamination and the available monitoring data in conjunction with a general understanding of the above site conditions, extensive experience by U.S. Steel's consultant, BCM Engineers Inc., with these conditions at similar nearby sites (primarily the Rohm and Haas facility in Bristol, Pennsylvania) and field observations of the site, permits an evaluation of various migration pathways and their relative importance.

A diagram of potential contaminant migration pathways is shown in Figure 15.

4.2.1 Groundwater Migration

Based on available data, the natural soils at the site have permeabilities ranging from 1.79 x 10^{-2} to 4.81 x 10^{-4} cm/sec (Chester Engineers, 1981), indicating that the soils are moderately permeable to very permeable. Some of the waste, including coke plant quench water, tar sludge, coke plant process wastewater and spent caustic solutions, and ammonia still lime sludge, can be potentially mobile in the environment. The potential for contaminant migration in the groundwater exists as indicated by the available groundwater data.

Although groundwater migration in the upper unconsolidated geologic formations onsite is an important pathway, this pathway in all likelihood leads exclusively to surface water receptors on or adjacent to the site. No groundwater is used onsite for human consumption. Experience at a similar nearby site furthermore indicates that the downward migration of groundwater into the bedrock formations is likely to be minimal or non-existent. The unconsolidated materials above the bedrock also contain silts and clays which greatly diminish the downward flow of groundwater and contaminants and accentuate the importance of horizontal migration in a downgradient direction towards surface water bodies. Hydrogeologic testing of the upper confining unit indicated vertical hydraulic conductivities ranging from 10^{-6} to 10^{-9} cm/s (Golder, 1988). The Delaware River is known to be a regional groundwater discharge zone. Therefore, vertical hydraulic gradients in deeper formations are expected to be upward.

Groundwater migration is thusly a principal (first step) potential pathway to onsite and offsite human receptors and to both the onsite surface water environment and possibly offsite surface water human and environmental receptors. The direction and rate of groundwater flow, particularly at the site boundaries, is therefore critical and will be an early focus of the RFI.

4.2.2 Surface Water Migration

The Delaware River and its tributaries transport water and sediment in a estuarine environment. This pathway includes both upstream and downstream flow directions because of the tidal nature of the Delaware. The Delaware is used for drinking water, recreation including fishing, and aquatic habitat and provides a migration pathway to both human and environmental receptors. The large flows in the Delaware provide significant dilution of contaminants which reach it via groundwater flow, soil surface runoff, or wastewater discharge. These dilutional effects, in conjunction with the diurnal variation in flow direction and the substantial number of discharges to the river (upstream and downstream) make an assessment of this pathway difficult and tenuous at best. Nonetheless, surface water and sediment migration in the Delaware River is likely to be a pathway for risk assessment.

A limited number of outlying borrow pits are within the 100-year floodplain. Since most pit contents are below grade, potential surface water migration of contaminants from those borrow pits is not expected. Some borrow pits also contain surface water and support habitat for environmental receptors.

4.2.3 Air Emissions

Most of the borrow pits are inactive and are covered with asphalt, slag, or vegetation, emissions of volatiles and particulates are not expected. An extensive evaluation of air emissions including fugitive dust including road dust from onsite activities was made for permitting of the sinter plant. The results of the testing program are summarized in Energy and Environmental Management's Report of 1989:

> Air quality studies show the Bubble program, as proposed, meets the Level II criteria under the Emissions Trading Policy for both the annual period (less than 5 ug/m^3 increase) and the 24-hour period (less than 10 ug/m^3). All modeled receptors experienced improved annual air quality under the Bubble. PSD increment consumption is well within the allowable standards. Also, a review of impacts to the National Ambient Air Quality Standard (NAAQS) under RACT emissions found no threat to NAAQS.

This evaluation was made at a point in time when the plant was far more active and thus represents a conservative evaluation of air migration as a pathway. In addition, air quality data collected by PADER does not indicate a regional air quality concern. Air migration is not, therefore, a major concern for the RFI.

4.2.4 Soil Contaminant Migration

Contaminant migration from exposed soils and wastes can occur via soil/waste runoff and by leaching of contaminants from soils and wastes downward to subsurface soil layers or to the groundwater table. Because the site is relatively flat, the transport of contaminants via surface water/sediment runoff to downgradient surface water bodies is not likely to be a significant pathway. However, leaching of contaminants from soils and wastes to the subsurface is dependent upon the nature of the wastes. For certain U.S. Steel soils/wastes, this is a significant pathway for migration to groundwater. Although access to the U.S. Steel site is restricted, the potential exists for worker and environmental receptor (e.g., ecological receptors) direct exposure to soil/wastes. This exposure pathway must be considered in the RFI.

4.2.5 Subsurface Gas

Based upon the waste characteristics, the generation of subsurface gas is not expected. No significant migration pathway exists and there is no apparent need to address this potential pathway.

4.3 CONCEPTUAL SITE MODEL FOR RISK ASSESSMENT

A conceptual model for the site is presented in Figure 16 for current and anticipated future site conditions. No quantitative risk evaluations have been performed.

4.3.1 Current Site Conditions

Current conditions at Fairless Works do not appear to be adversely impacting human health (onsite or offsite), nor do they appear to present any immediate or substantial endangerment to the environment. Interim measures were undertaken to address the only currently known potential adverse impact to wildfowl at BP-35. There are no known circumstances where contaminant migration is advancing offsite.

The site is isolated from residences and located in a large industrialized area of Falls Township. No impacts to demography and land use are indicated nor is there any evidence that the current conditions are restricting groundwater or surface water use.

The data available to evaluate the impact of current conditions is incomplete. The RFI will involve collecting additional data and re-evaluating potential impacts.

4.3.2 Future Site Conditions

The site has been used as a steel manufacturing facility since 1952. The iron-making and steel-making operations have ceased. Steel finishing operations are still active. In addition, some of the facilities, including the pipe mill and rod and wire mill buildings, are presently being leased to others. Demolition of closed operations has begun, starting with the coke plant, sinter plant, and blast furnaces. The open hearths, electric arc furnace, and rolling mills are also scheduled for demolition. Demolition will include removal of aboveground structures and filling of basements, sumps, and tunnels. Following demolition, future plans for the site include the expansion of the USX Industrial Park into the former manufacturing areas. U.S. Steel believes that potential future offsite exposures will decrease as the industrial park is established and more of the site is occupied by impervious surfaces (buildings and paved areas) and vegetated areas.